

RADIOLOGIC ASSESSMENT OF LOW BACK PAIN

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The choice of appropriate handling of patients with acute or chronic low back pain is difficult and the problems also extend to the radiology department. The role of the radiologist in the investigation of low back pain is primarily to identify a process amenable to surgical treatment.

The first radiological examination in patients with low back pain should always be plain a-p and lateral radiography of the lumbosacral spine supplemented by oblique exposures where spondylolysis is suspected. The main objective of this study is to detect anomalies like spondylolysis, spondylolisthesis, infection, malignant destruction and ankylosing spondylitis. The timing of lumbosacral radiography in relation to clinical history may differ. With exception of patients with progressive paresis or bladder / bowel disturbances, the patients are advised to have at least two weeks of conservative treatment before radiography of the lumbo-sacral spine is carried out. If in spite of the conservative treatment, the patient still has pain and the plain films are non-specific, the patient should be referred to CT.

CT can reliably depict the cause of low back pain in many patients. In comparison to myelography it has the advantage of being noninvasive. Many comparative studies have shown that CT has a slightly higher diagnostic accuracy and can replace myelography in many instances (1,2). CT is excellent at defining anatomical detail. But the radiologists require accurate clinical information in order to choose the proper CT scanning technique and to correlate the CT findings with the presenting symptoms.

2 different CT scanning techniques may be employed for imaging the lumbar spine between L3 and S1. The first employs a series of angled scans coaxial to the intervertebral disc space, starting at the inferior aspect of the pedicle and ending at the superior end plate. With this method, central canal stenosis, free disc fragments or spondylolytic defects may be missed unless the whole vertebrae are scanned additionally. The alternative method involves nonangulated contiguous images covering the whole spine. By this method, excessive lordosis can produce distortion and misdiagnosis of disc disease. With the latter technique sagittal and coronal reconstructions are possible allowing direct comparisons at different levels.

In most patients with low back pain the correct diagnosis can be made by unenhanced CT. Intrathecal non-ionic contrast medium should be employed when the results of plain CT do not correlate with the patients, symptoms. Myelo-CT is necessary to exclude intra-dural abnormalities and the presence of arachnoiditis. A plain film myelography prior to myelo CT may show the exact level of abnormality or can be of advantage to show the stability of the spine during movement.

The most important remediable cause of low back pain is the prolapsed intervertebral disc. 2 patterns of disc disease may be observed with CT. The first is a broad annular bulge, presenting as a smooth convexity impinging on the thecal sac and obliterating the epidural fat. This corresponds to an annular bulge type of disc disease. The second pattern is a discrete nodular posterior bulge of the disc which corresponds to a prolapsed disc herniation. Often these two entities may exist together. When the posterior border of the disc has a severe nodular bulge, an extruded disc herniation can be diagnosed. When a nodular disc bulge is seen to extend above or below the level of the disc, or is noted to be separated, the CT diagnosis of a sequestered fragment is made. In the CT diagnosis of lumbar disc rupture, the obliteration of the anterolaterally located epidural fat, the distortion of the thecal sac and the displacement of a nerve root are of high diagnostic importance. The enlargement of an irritated nerve root distal to the compressed root may serve as a confirmatory finding (3).

It is important to trace the extent of an abnormal disc bulge both cephalad and caudad to the disc level itself. The caudad extension of a disc bulge or herniation may contribute to the compromise of the central canal or lateral recess of the vertebral body distal to the disc space. Occasionally, a laterally bulging disc rupture encroaches upon the nerve root in the neural foramen. Sometimes calcification or ossification of the protruding broad-based annulus fibrosis is noted.

After a disc operation, the epidural fat of the spinal canal can be replaced by fibrosis and a recurrent disc may be difficult to evaluate. By I.V. contrast application it may be possible to distinguish between scar, disc and theca.

The sensitivity of CT in diagnosis of the herniated disc is approximately 95 per cent which is slightly superior to that of myelography. It is increasingly apparent that CT is the first diagnostic procedure to follow conventional radiographs in evaluating the patient suspected to have a ruptured lumbar disc (1).

A common aetiology of low back pain is due to cauda equina compression and nerve root entrapment secondary to spinal stenosis. Spinal stenosis is the narrowing of the spinal canal due to bony and/or soft tissue hypertrophy of the surrounding walls. In a broader sense, the spinal canal can also be narrowed by an intervertebral disc herniation or by a space occupying soft tissue (4). Ligamentum flavum hypertrophy and/or calcification, thereby consequent encroachment on the dural sac may cause spinal stenosis without the narrowing of bony canal. Similarly a diffuse annular disc bulge may result in central canal stenosis. Spinal stenosis may result from hypertrophy of the superior articular facets (in degenerative spondylosis) and cause a trefoil configuration of the spinal canal.

Lateral recess is an area bordered laterally by the pedicle, posteriorly by the superior articular facet and anteriorly by the posterior lateral surface of the vertebral

body. Hypertrophy of the superior articular facet is likely to result in lateral recess stenosis and nerve root compression.

Careful evaluation of the lumbar apophyseal joints by CT is beneficial since inflammatory or osteoarthritic joint disease may cause low back pain which is clinically indistinguishable from that of ruptured lumbar disc. The symmetry of the facet joints can be evaluated by CT. Farfan stressed the high correlation between the side of an unilateral disc protrusion with the side of the more oblique facet joint.

Spondylolysis can be well appreciated on axial CT scans. The bony-defects in the pars interarticularis are more coronally oriented than the facet joints and are usually visualised in the same scan slice as the transverse processes. Spondylolysis may become more apparent if spondylolisthesis is present.

Sacroiliitis may also be the cause of low back pain. CT has proved to be more sensitive and equally specific in the diagnosis of sacroiliitis when compared with conventional radiographs. CT images are diagnostic of sacro-iliitis when joint space is narrowed to less than 2 mm, when sclerosis, erosions are identified in the synovial compartment of the joints.

CT enables the study of the vertebrae, the discs, the epidural and paraspinal regions when involved by infectious disease. Interpretation of the CT of an operated patient is not simple. Post operative infection becomes evident after at least 2 weeks. Because both resolving hematoma and abscess may appear as a paraspinal mass with central lucency. A needle aspiration biopsy under CT guidance may be necessary.

No doubt that CT is a rapid, harmless, sensitive and accurate diagnostic tool. The greatest limitation of CT is the poor distinction of the spinal cord from the subarachnoid space. Myelography should be reserved for patients whose clinical findings can not be explained by CT, when the level of the abnormality can not be clinically defined or when intradural pathology has to be excluded. Myelography is the procedure of choice to delineate the presence and degree of arachnoiditis. The earliest findings are blunting of the axillary nerve sleeves, non filling of the root sleeves and progressive clumping of the roots. With MR nuclei pulposa and the articular cartilages may be imaged directly and sections may be obtained in any plane. It is also hoped that post operative disc material can be distinguished from fibrosis (5).

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THE EFFECT OF LIDOCAINE ON SPINAL CORD LIPID PEROXIDE LEVELS IN ACUTE SPINAL CORD INJURY

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The major disorders of the CNS generally involve some type of regional cerebral ischemia and/or trauma. Various model systems in laboratory animals have been developed to mimic regional cerebral ischemia and traumatic events such as spinal cord injury (1, 2). Demopoulos et al. (1) have hypothesized a scheme of biochemical events that may lead to spinal cord injury. In this scheme, production of various free radical species such as superoxide radicals, hydrogen peroxide and hydroxyl radicals are postulated to have a central role. Free radicals are reactive species containing one or more unpaired electrons. These molecules can undergo three major reactions in a cell; reactions with lipids, proteins or DNA. Chemical modification of these molecules leads to metabolic and structural modifications of cells which can ultimately cause cell death (For review see 3-5).

The unsaturated bonds of membrane cholesterol and fatty acids can readily react with free radicals and undergo peroxidation. Peroxidation of fatty acids containing three or more double bonds will produce malondialdehyde. The presence of this oxidation by-product can be measured with thiobarbituric acid which correlates with the extent of lipid peroxidation (6).

Demopoulos et al. (1) have treated regional cerebral ischemia and spinal cord injury models with lipid-soluble barbiturates which successfully prevented the lipid free radical changes. Lidocaine, a compound known to have a membrane-stabilizing effect, is one of the most frequently used local anesthetic for spinal anesthesia (7). In the present study we have investigated the effect of lidocaine pretreatment on spinal cord lipid peroxide levels after cord trauma in an experimental model.

MATERIAL AND METHOD:

In this study, 20 Wistar strain rats weighing 300-350 g-were used. Rats were divided into control and lidocaine-treated groups. A surgical procedure causing standard spinal cord trauma was performed on both groups (8). Lidocaine-treated group received 5 mg/kg of lidocaine i.p. 15 minutes before operation.

Surgical procedure:

Rats were anesthetized using ketamine and pinned in supine position. Following T3-T11 midline incision, T4-T10 spinous processes and laminar arcs were removed under the surgical microscope. Spinal cord was exposed after paravertebral muscle dissection.

Spinal cord was squeezed by Yaşargil aneurysm clip for 45 seconds and then removed by cutting the two ends. By this procedure it was possible to standardize spinal cord trauma in all rats. The presence of trauma was confirmed by histopathological findings.

Lipid peroxide determination:

Traumatized cord tissue was homogenized with trichloroacetic acid to give a 10% tissue homogenate. Lipid peroxide determination was carried out in the homogenate according to Casini et al. (6). Plasma lipid peroxide levels were determined in plasma obtained using EDTA as an anticoagulant. All results were expressed in terms of malondialdehyde (MDA) equivalents.

RESULTS AND DISCUSSION:

Demopoulos et al. (1) emphasized that in spinal cord injury, the initiation of pathologic free radical reactions is mediated by the initial extravasation of blood in to the central gray matter. The amount of low molecular weight free radical scavengers and antioxidant enzymes is rather low in cerebrospinal fluid. Therefore, it is very difficult to prevent oxidative damage in the central nervous system.

Various agents including mannitol, barbiturates, corticosteroids have been used as exogenous free radical scavengers to support endogenous defenses against oxidative changes (5). Astrup et al. (9) have reported that lidocaine has a barbiturate-like effect in addition to its membrane-stabilizing properties. In the present study we have attempted to investigate whether lidocaine has any effect on lipid peroxide levels in traumatized-spinal cord tissue.

Plasma and spinal cord lipid peroxide levels after cord trauma in the control and lidocaine-treated groups are given in Table 1. It was observed that spinal cord lipid peroxide levels were significantly decreased in lidocaine-treated group. On the other hand plasma lipid peroxide levels were not significantly different in the two groups.

In conclusion, the results obtained in this preliminary study suggest a preventive role of lidocaine against lipid peroxidation in experimental spinal cord trauma. We believe that further studies are required to elucidate the mechanism of the effect of lidocaine on lipid peroxidation.

TABLE 1. PLASMA AND SPINAL CORD LIPID PEROXIDE LEVELS AFTER CORD-TRAUMA IN CONTROL AND LIDOCAINE-TREATED RATS

	Control (n=10)	Lidocaine-Treated (n=10)
PLASMA		
(nmol MDA/ml plasma)	4.8 ± 0.9	4.5 ± 1.1
SPINAL CORD		
(nmol MDA/g tissue)	17.0 ± 3.7	11.8 ± 2.3*

Values represent mean ± SD

(*) p < 0.001 compared to the control group.

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COMPARISON OF ENFLURANE AND HALOTHANE ANAESTHESIA FOR LAMINECTOMY

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Halothane and enflurane are inhalation anaesthetic agents and the physical and anaesthetic properties of these agents are closely related (1). Enflurane however, has proved to be less arrhythmogenic than halothane (2, 3, 4). Furthermore, the recovery after enflurane anaesthesia has been shorter than that after halothane anaesthesia (5, 6, 7).

Enflurane also has some advantages. There is a circulation stability during enflurane anaesthesia (8, 9, 10). Postoperative side effects, nausea and vomiting occurs less frequently than that after halothane (4, 11). Halothane causes a hypotension and this hypotension is due to a reduction in cardiac output (4, 11). Hypotension is a serious problem of prone position.

The purpose of this study was to compare the cardiovascular effects, recovery time and postoperative side effects of enflurane and halothane anaesthesia for laminectomy.

MATERIAL AND METHOD:

Thirty patients (12 female, 18 male) between the ages 22-63 undergoing laminectomy were randomly divided into two groups receiving either enflurane or halothane anaesthesia. Patients were specifically excluded if they suffered from cardiac, pulmonary, renal or hepatic diseases. The patients were premedicated with atropine 0.5 mgr and pethidine 50 mgr intramuscularly. Anaesthesia was induced with thiopentone sodium 5 mgr/kg I.V. Endotracheal intubation was facilitated with suxamethonium 1 mgr/kg I.V. in both groups. Anaesthesia was maintained with either enflurane or halothane in 70% nitrous oxide.

Enflurane was commenced with 2.5 vol % and halothane 1 vol % gradually reducing the concentration of enflurane to 0.5-0.8 vol % and that of halothane to 0.3 - 0.5 vol %. A semi-closed circuit system with CO₂ absorption was used. Ventilation was manually assisted or controlled maintaining the end tidal CO₂ concentration at 4.5-5.5 vol%. The patient's heart rate, blood pressure and ECG changes were continuously recorded. The changes in heart rate, blood pressure and the frequency of electrocardiographic changes were measured. Recovery time from extubation of trachea to rejection of oral airway was estimated. The occurrence of nausea and vomiting and any other side effects in recovery room were noted and the intensity of pain requiring treatment with analgesics was assessed. Student's t test was used for statistical analysis of the data. The scheduled surgical procedures were similar for both groups of patients.

RESULTS:

The two groups were comparable as regard age, sex, body weight and duration of anaesthesia (Table I). The mean duration of operation was 161 ± 26 minutes in enflurane group and 153 ± 14 min. in halothane. The minimum and maximum changes of the blood pressure and heart rate during enflurane anaesthesia were found to be insignificant ($P > 0.05$, Table II). The blood pressure decreased significantly in comparison to control values ($P < 0.05$) during halothane anaesthesia. The changes of heart rate were found to be insignificant ($P > 0.05$) in this group (Table II).

ECG changes, junctional rhythm and ventricular extrasystoles occurred in 13.3% of the patients during enflurane anaesthesia; the corresponding figures were 33% during halothane anaesthesia. There was a significant difference in changes of ECG between enflurane and halothane. The most common ECG changes were ventricular extrasystoles in both groups.

Recovery time was 5.6 ± 2.4 min in enflurane group and 11.8 ± 4.6 min in halothane. There was a significant difference related to recovery time between enflurane and halothane ($P < 0.05$). In the recovery room the most common side effects, nausea and vomiting occurred in two patients in the enflurane group. These parameters in halothane group were 26.6%. There was a significant difference in postoperative side effects between enflurane and halothane anaesthesia. 11 patients who received halothane required analgesics in the recovery room. Only 4 patients needed analgesics in the enflurane group.

DISCUSSION:

The present results show that there was cardiac stability, shorter recovery time and less postoperative side effects with enflurane than with halothane. It is already known that there is minimal cardiovascular depression and a stable cardiac rhythm during enflurane anaesthesia (8, 9, 10). The blood pressure and heart rate remained unchanged during enflurane anaesthesia. Halothane caused a significant decrease in blood pressure. These results are supported well with the findings of Reynolds (12), Krishna (13) and Heiberg (14). Many investigators have shown that ventricular ectopic beats were more common during halothane than enflurane anaesthesia (15, 16). The difference between enflurane and halothane has been explained by the different actions of the anaesthetics on the conduction time at the atrioventricular node and His-Purkinje fibers. Enflurane lowers the conduction time at the AV node but has no effect on the Purkinje fibers (15, 16), halothane lowers the conduction time at both AV node and the His-Purkinje fibers (15, 16).

The recovery time was shorter with enflurane than halothane during laminectomy. This result is supported by the different blood gas solubility coefficients of enflurane (1, 9) and halothane (2, 3). Furthermore, the present result agrees well with the results of Lindgren (4), Stanford (6), Davidson (11), Govaerts (17), Strunin (18). They have found that recovery from enflurane was quicker than that from halothane anaesthesia. Nausea and vomiting occurred in 2

patients in the postoperative period in enflurane group and 4 patients in halothane group. There was a marked difference in postoperative side effects between enflurane and halothane. These findings are supported well by Lindgren (4), Davidson (11) and Govaerts (17) results. In the postoperative period only 4 patients who received enflurane required analgesics.

In the postoperative period, 11 patients who received halothane required analgesics. There was a marked difference in postoperative analgesia requirements between enflurane and halothane anaesthesia. Analgesia requirements in the first 24 hours are minimal with enflurane anaesthesia (10). In the scope of this data we suggest that enflurane is a more suitable inhalation anaesthetic agent than halothane for laminectomies.

TABLE I: DEMOGRAPHIC DATA (MEAN VALUE \pm S.E. MEAN)

	Age (Years)	Sex (Female/Male)	Weight(Kg)	Duration of Anaesthesia (Min)
Enflurane	43.8 \pm 11.4	6/9	73.6 \pm 13.1	161 \pm 26
Halothane	42.9 \pm 10.8	6/9	74.8 \pm 12.9	153 \pm 14

TABLE II: CHANGES IN HEART RATE AND SYSTOLIC BLOOD PRESSURE (MEAN VALUE \pm S.E. MEAN)

	Enflurane	Halothane
Heart Rate (Beats/Min)		
Control Value	88 \pm 3.4	91 \pm 2.6
Lowest Value	84 \pm 2.8	78 \pm 1.9
Highest Value	92 \pm 1.7	97 \pm 2.6
Systolic Blood Pressure (mmHg)		
Control Value	126 \pm 2.4	124 \pm 1.9
Lowest Value	118 \pm 1.5	80 \pm 3.8
Highest Value	131 \pm 1.6	128 \pm 2.3

TABLE III: ECG CHANGES DURING ENFLURANE AND HALOTHANE ANESTHESIA

	Enflurane n-15	Halothane n-15
Junctional Rhythm	1	1
Ventricular Ectopic Beats	1	3
ST Segment Changes	-	1
QRS Complex Changes	-	-

n-Number of the Patients

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TRANSPLANTATION OF FETAL BRAIN GRAFTS IN THE SPINAL CORD OF ADULT RATS: AN ELECTRON AND LIGHT MICROSCOPIC STUDY

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Regeneration in the central nervous system and especially in the spinal cord of mammals has interested a large number of workers for more than a century. A major trend in paraplegia research has been the study of central nervous regeneration and reconstruction (1, 2, 3, 4, 5). The first paper on regeneration in young or adult mammals showed graft survival in the spinal cord in 1928 (6, 7). Some authors investigated the functional effects of peripheral nerve grafts implanted into rat spinal cord and found evidence of functional improvement in a small proportion of animals in 1940 (8). In 1970 Kao et al. reported autotransplantation of cultured cerebral or cerebellar tissues into the transected spinal cord of the adult dogs and observed beneficial change on wound healing process (9).

It has been demonstrated that embryonic neural tissues can be successfully transplanted into adult spinal cord and found that the implants grow, differentiate and become anatomically integrated with nerve terminals of host. Delayed transplantation has better survival (1, 3, 9, 10, 11, 12, 13).

In this study, the effect of fetal neural grafts on the transected spinal cords was investigated and ultrastructural and light microscopic studies were performed.

MATERIAL AND METHOD:

In this study, rats were divided into 3 groups and total 30 rats used.

In the Experimental group I (n:10) fetal neural tissues were directly injected into the transected spinal cord after preparing cavity for implantation on the left posterior column.

In the Experimental group II (n:10) after preparing cavity, fetal graft implanted a week later (Delayed transplant).

In the Sham group (n:10) same procedure was performed without graft.

For this investigation Norvegicus Albino male (200-250 gm) rats were anaesthetised with sodium thiopental (30 mg/kg) I.P. Dorsal region of the rat was prepared and laminectomy between Th9-12 performed. Dural incision was done on the lateral dorsal column near the dorsal root entry zone. After arachnoid and pia incision, 2-3 mm³ dorsal column medulla was aspirated for producing a lesion and a cavity for implantation of graft. After careful hemostasis, in Group I, the graft which was obtained from 17-18 day old embryo's frontoparietal region was implanted by injection method which was described by Das et al. (14, 15, 16). After implantation dura was left open. Fascia and muscle were closed. In the second experiment group (delayed implant) a similar cavity was prepared and a week later, after scar tissue removal, graft was implanted just like the first group. In control group all surgical procedures were performed without graft implantation.

Two months later all animals were decapitated and spinal cords were removed for light and electronmicroscopic investigation. For the light microscopy, the specimens were fixed in 10% formalin and then paraffin blocks were prepared. Transvers slices were obtained and stained with Hemotoxylene&Eosin and myelin stain.

Specimens for electron microscopic examination were kept in 25% Glutaraldehyde+phosphate tampon two hours at +4 C in the refrigerator. 1% Osmium tetroxide was used for postfixation and then acetone series were used for dehydration. 400-600 Å thin slices were obtained from Vestopal block by glass knife with LKB ultratom and Reichert UM 3 ultramicrotome for electron microscopic investigation. Thick slices were contrasted by 1% toluidin blue. Thin slices were investigated with Jeol 100 C and Zeiss EM 9 electron microscope and electronmicrographs were obtained.

RESULTS:

Light and electron microscopic investigation results in the immediately grafted group showed that the grafts, although survived became significantly smaller in volume. Large cavity formations and increased collagen tissue and damaged vascular structures were observed. There were paranchymal connections in only two rats (20%). However survived neurons were observed however in most occasions in small numbers. Regenerations of spinal axons did occur. But the majority of spinal axons ceased their activities at the cystic wall which was surrounded with fibrous tissue. (Figure 1, 4, 5).

In the delayed grafted group the number of surviving neurons were found to be increased in volume. These transplants were seen to grow large and partially fill the cavity and were tightly opposed to spinal cord paranchyma. Pathological changes such as vacuolisation or fibrous tissue were not seen (Figure 2, 3, 6, 7, 8).

DISCUSSION:

It has been demonstrated that following partial denervation of neurons, intact axons in the degenerative zone can sprout to reinnervate partially denervated neurons. Although the mechanism for sprouting are unknown the fact remains that axonal sprout can be elicited following partial denervation of neurons in various regions of the peripheral and central nervous system (1, 3, 9, 10, 14, 16, 17, 18, 19, 20). But the regenerating axons do not grow through the reactive neural zone which appears in the posttraumatic period and thus do not reach the neuroglial scar. Attempts to remove this barrier have been tried in many investigations without much success (9, 11, 13, 14, 21, 22, 23, 24, 25). Some drugs have been used for this purpose but none were found effective (22, 23, 24, 26). Using isolated grafts of arteries and nerves, wrapping the cord in inorganic sheat, insertion of centrally connected peripheral nerve stumps across the transection site into the cord and implantation of cultured neurons have been tried. These studies have shown that implanted tissue soon becomes necrotic and increases the scarring whereas cultured tissue has tendency to decrease and reorient the scar tissue (1, 3, 6, 15).

A major problem in the spinal preparations is the lack of retention of neural tissues within the paranchyma of the spinal cord. This was found particularly evident when the neural tissues were injected in to the intact spinal cord (1, 3, 15, 16, 27, 28, 29). The initial retention of transplants was considerably improved by making room as surgically prepared cavities in the host spinal cord that allowed transplants to stay within the spinal cord closely juxtaposed to its paranchyma. This contributed to the transplant becoming paranchymally integrated with the spinal cord instead of remaining extraparenchymal (1, 3, 11, 15, 16).

Partial or complete transection of the host spinal cord for transplanting neural tissues in the surgically prepared cavities inevitably results in pathological changes at the site of transplantation. Following total transection, the pathological changes are far more extensive and long lasting than after partial transection (1, 2, 3, 8, 9, 14, 15, 20, 30, 31). In the partially sectioned spinal cord where cavities for transplantation are made, the pathological changes are relatively reduced (9, 14, 15, 16, 32).

In our study, in the immediately grafted group the grafts although surviving became significantly smaller in volume. Large cavity formations and increased collagenous tissue and damaged vasculer structures were observed. There were paranchymal connections in only two rats (20%). Surviving neurons were observed however in most occasions in small numbers. Regeneration of spinal axons did occur. But the majority of spinal axons ceased their activities at the cystic wall which was surrounded with fibrous tissue. Our findings are similar with other studies (1, 3, 9, 15, 16).

In the delayed grafted group the number of surviving neurons were found to be increased compared to the first group. These transplants were seen to grow large and partially fill the cavity and were tightly opposed to spinal cord paranchyma. There was no evidence of vacuolisation or fibrous tissue. The increase of volume and graft survival was found better in delayed grafting as suggested by the others (1, 3, 4, 6, 9, 10, 12, 15). Also delayed cavity produces a more satisfactory vascular bed for graft survival.

It was also reported that even with the subpial implantation technique, the successful result of immediate grafting was disturbed by Cajal's autotomy (2, 7, 8, 20, 25, 33). The delayed grafting prevents the occurence of this phenomen. But if the spinal cord is traumatized during the delayed grafting autotomy occurs again and the grafts are seperated from the terminal clubs of the spinal cord axons by cavities (3, 9, 12, 28, 29, 30).

The use of neocortical tissue increases the healing process of spinal cord wound and regenerative activity. The regenerating axons and axonal sproutings produce new synaptic complexes and in many cases restore the lost function (15, 16, 31, 33, 34, 35).

In conclusion, fetal brain grafts which were transplanted into the spinal cord in the early stage although surviving could not fill the whole cavity and could not connect with the normal paranchyma except in rats. In contrast, in the delayed grafted group the grafts filled the cavity significantly more than the first group and connected to the host spinal cord.

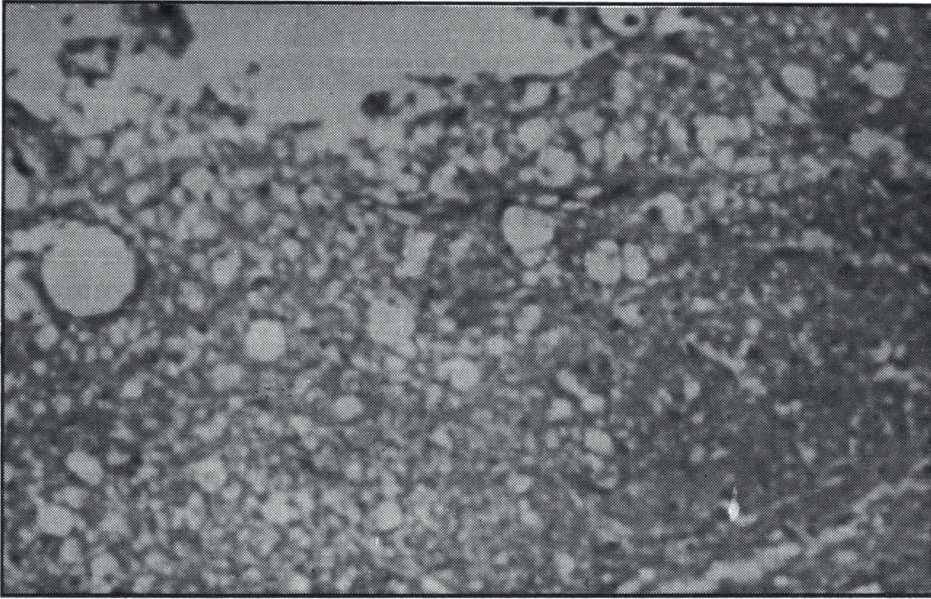


FIG.1: Inside the cavity, the remnants of graft (G) and demonstration of large vacuolisation, spongy structures and fibroglial scar tissue formation.

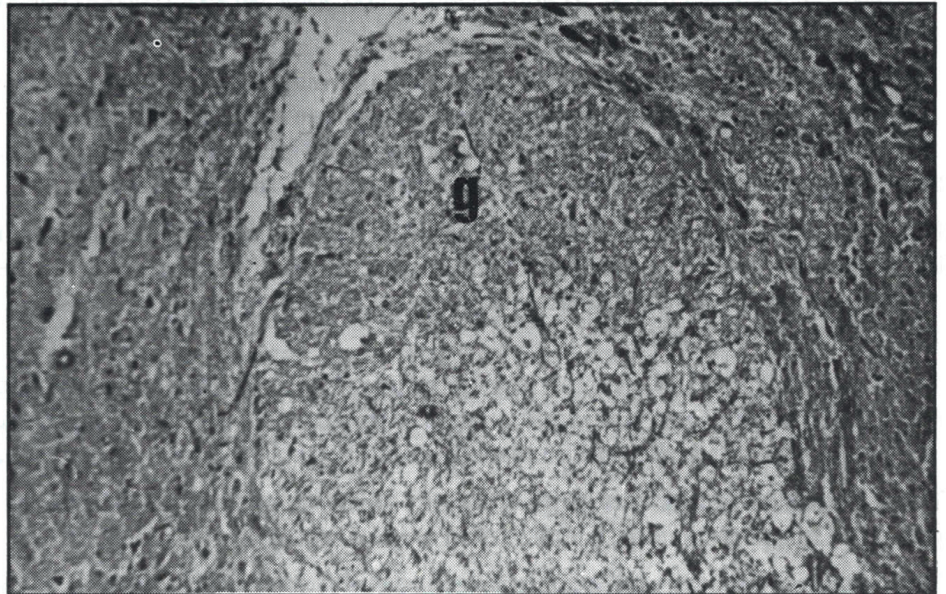


FIG..2: In the delayed grafted group, good connection of graft and host tissue.

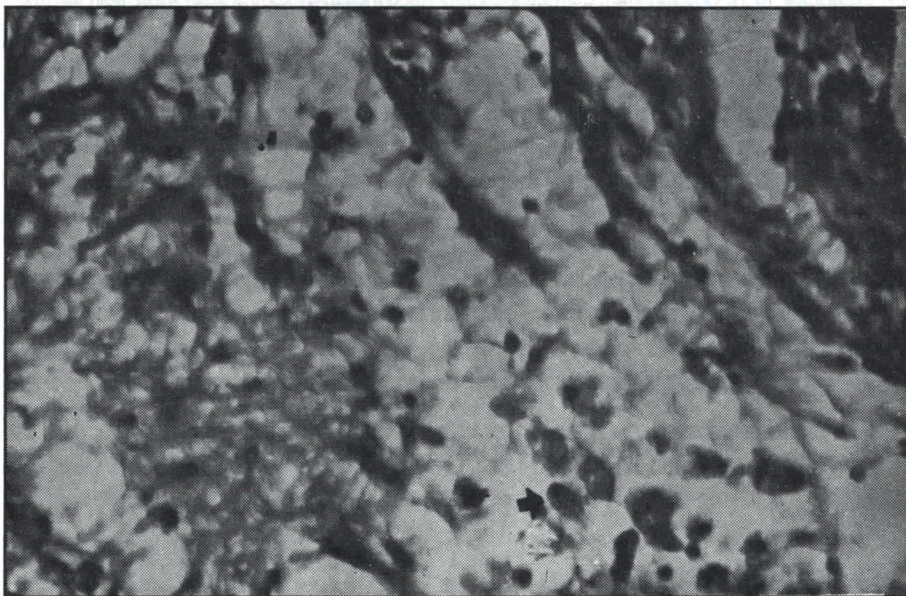


FIG.3: Surviving neural structures in the delayed grafted group. (arrows)

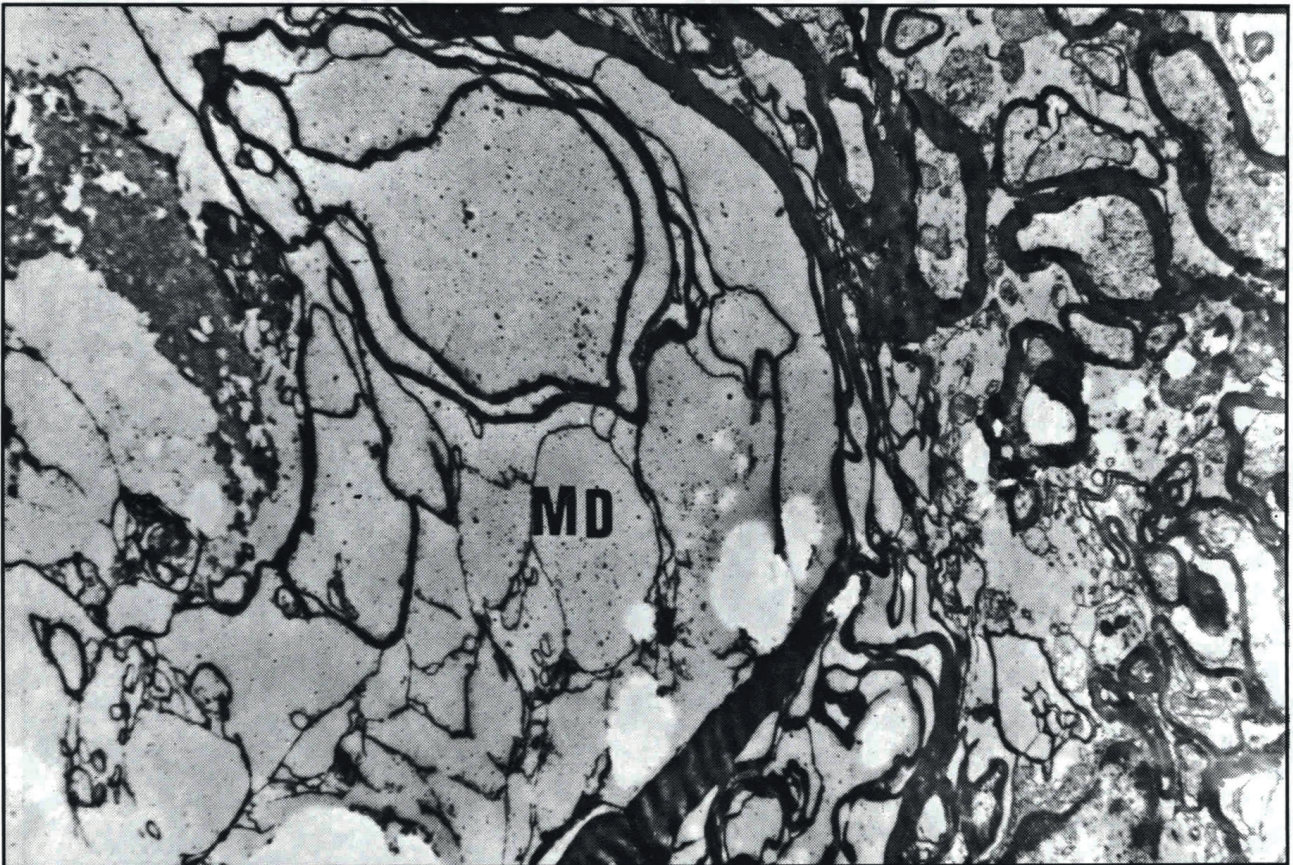


FIG.4: A small number of surviving normal myelinated axons and beside that area diffuse delamination of myelin in early grafted group. MD: myelin delamination (5000 X).



FIG.5: In the early transplanted group NM: normal myelin, CF: collagen fibrils. (5000 X).

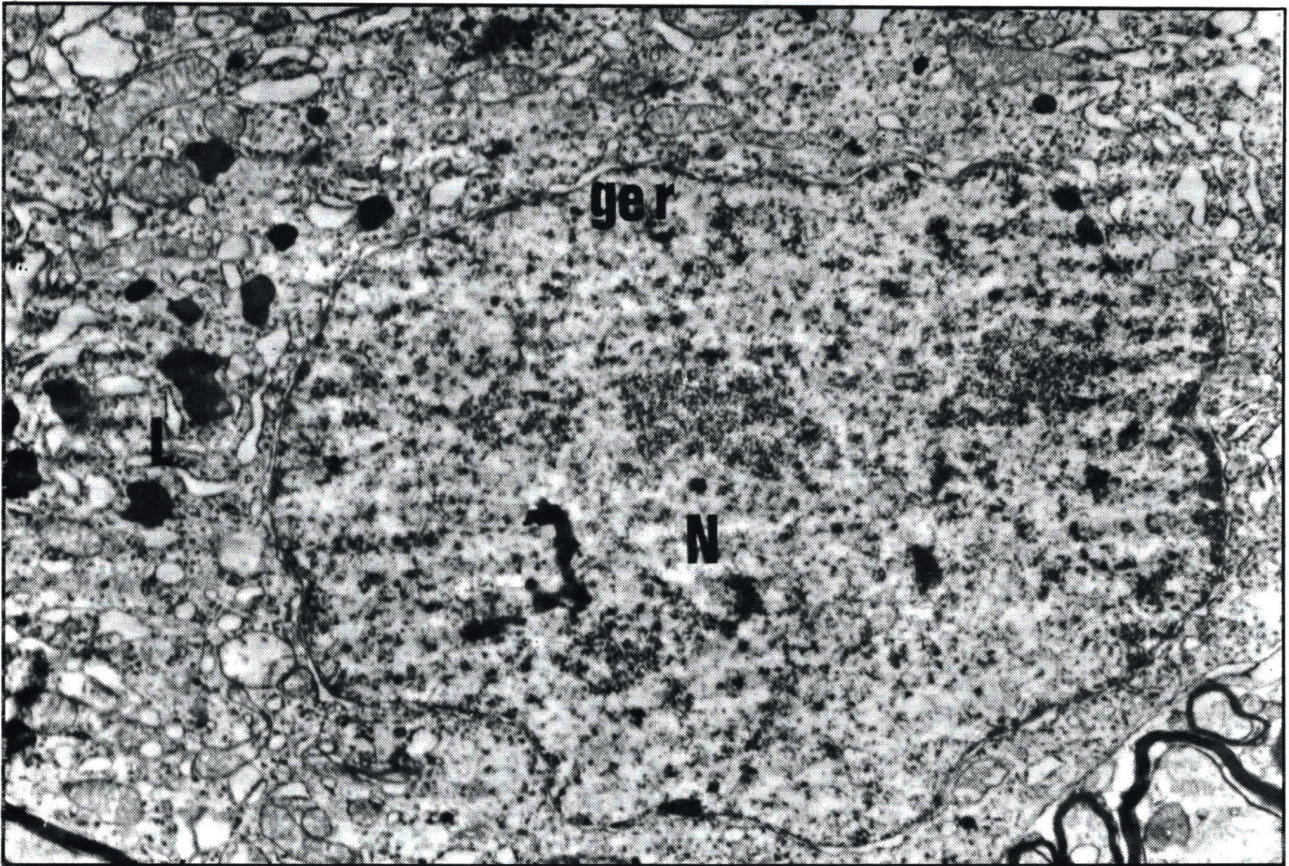


FIG.6: Good survival and normal neuronal structures in delayed grafting group GER: granular endoplasmic reticulum L: lipofuscin (12.500 X).

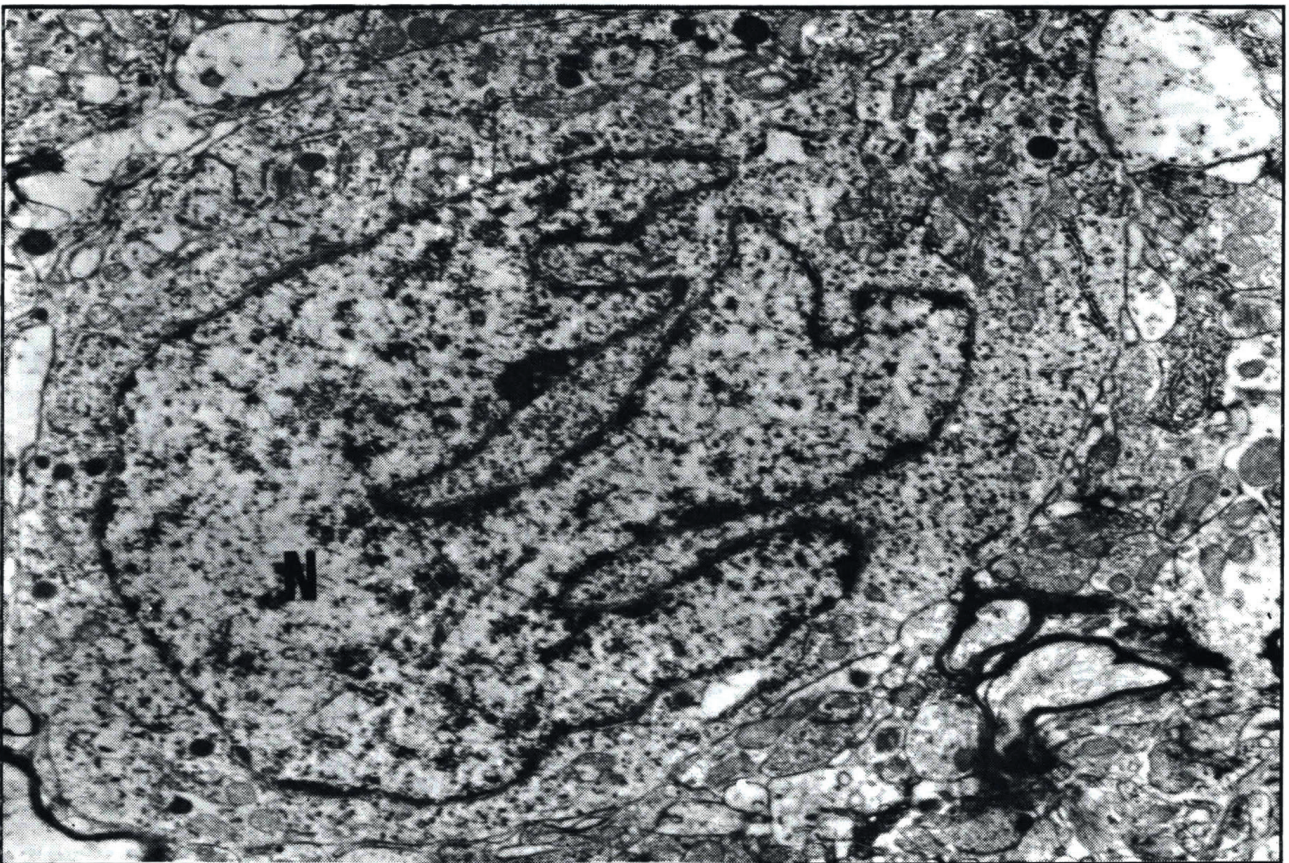


FIG.7: The lobulated nucleus of the survived neuron in the delayed group N:nucleus (12.500 X).

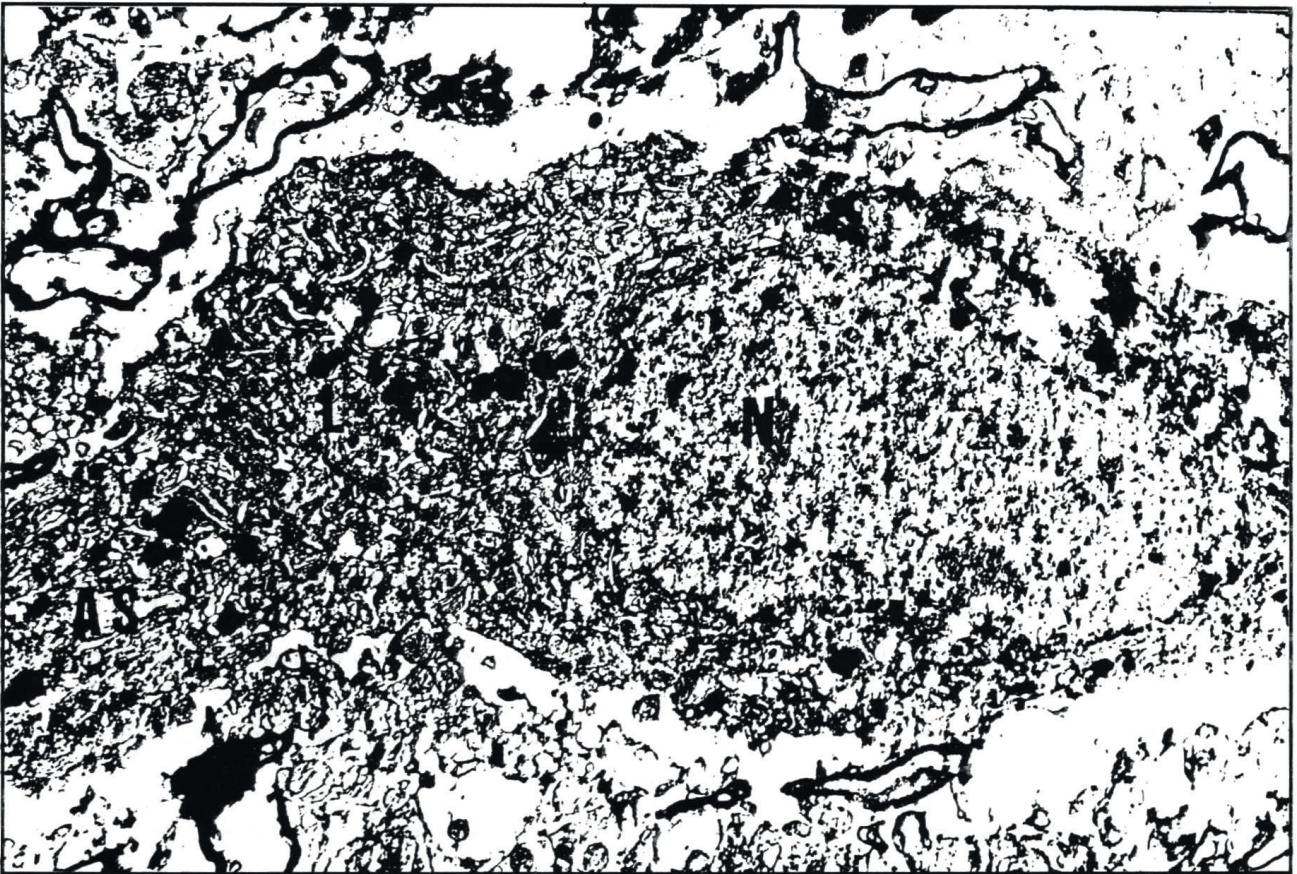


FIG.8: Axonal graft into the host tissue in the delayed grafted group. N: nucleus, L: lipofuscin, AS: axonal sprout (5000 X).

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SPINAL TUMORS (Review of 59 Cases)

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Credit is given to Sir Victor Horsley for the first successful removal of a spinal tumor 100 years ago (1). The knowledge of symptomatology, neuroradiological methods and surgical treatment have been advanced to a certain level that was only a dream as Elsberg noted in 1920's (7).

CLINICAL MATERIAL AND METHOD:

377 cases of brain tumors and 59 spinal tumors were operated upon in our clinic between 1981 and 1987. Of the cases with spinal tumors there were 35 male and 24 female, the youngest being 3 and the oldest 71 years old.

The most common site was thoracic and the next lumbar region, with 33 (59%) and 14 (23,7%) patients respectively. In cervical area, there were 12 patients (20,3%), in a number rather close to that of lumbar region.

Direct X-ray graphics revealed abnormal findings in only 5 cases (8,4%). Destruction in the vertebral body was observed in two patients with plasmocytoma, and interpediculate widening and thinning of the pedicles in one patient with meningioma. In two patients with neurilemmoma, foraminal enlargement was detected.

Myelography and cerebro-spinal fluid (CSF) analysis were routinely employed in all of our cases. The data obtained from CSF was not found to be helpful except the elevated protein content. Myelographic investigations were done mostly with the use of water soluble and occasional lipid soluble contrast material. All of the cases with cervical localisation presented myelographic appearance of total block. The patients with lumbar or thoracic lesions exhibited either total or subtotal block of the contrast material. We have met no worsening of clinical picture after lumbar puncture.

Bone scintigraphy was applied to the cases in which lesions were thought to be metastatic in origin. Although increased osteoblastic activity could be observed particularly in cases with vertebral destruction, no single case of multiple involvement was detected, hence its value as a diagnostic procedure was rather limited.

Spinal computerized tomography (CT) has become more frequently used in the last two years in our clinic. Although myelography is still the procedure of choice on account of the socio-economical problems of our patients, we preferred having Iohexol (Omnipaque) CT scans after myelography done. In 16 patients, we could have the chance of getting CT scans, and the tumor itself as well as its anatomical relationship with the adjacent structures were well documented in each case.

In all of the cases, the operative approach was standart posterior laminectomy. The patients with malignant neoplasms were referred to postoperative radiotherapy.

It has not been possible to follow all of our patients for acceptable postoperative periods. In the early postoperative period, no significant change was noted in three cases with intramedullary astrocytomas and five cases of metastatic tumors. Still, all three patients with intramedullary astrocytomas maintained their neurological conditions as they presented 6 months after surgery. In one of the metastatic cases, the patient regained the ability of walking in the first three postoperative months, however failed to return for follow up.

Of our cases with cervical localisation exclusive of intramedullary ones, only three have been followed up, and they all have become able to resume their daily activities. Excellent results were obtained in those with meningiomas, neurilemmomas and neurofibromas, 23 of whom we followed closely, without any recurrence.

DISCUSSION:

It is generally accepted that spinal tumors are relatively uncommon. In three different series, the ratio of intracranial neoplasms to spinal tumors was given as 4/1, 9/1 and 5/1 (2, 3, 4). In our series this ratio being 6,3% exhibits a good correlation with that of the literature. The age distribution shows a peak in the fifth and sixth decade which is what was expected since the cases of meningiomas, neurilemmomas and metastases made up approximately 45% of our cases.

In a review of 1322 spinal tumors, Sloof et al. reported that 29% were neurilemmomas, 25,5% were meningiomas, 22% were gliomas, 11,9% were sarcomas, 6,2% were vascular tumors and 8,1% miscellenous (epidermoid, dermoid, lipoma, chordoma etc) (6). If we compare these incidences with that of our series, although the relative incidences of meningiomas and neurilemmomas are rather close, the most striking feature is the much lower occurrence of ependymomas and astrocytomas in our series. This could be best explained by the great discrepancy of the number of the cases between the two series.

Analysing the complaints on admission, it can be clearly seen that in an overwhelming number of patients neurological deficit was incomplete. It should also be noted that more than one tenth (13,4%) of the patients applied to the clinic with only the complaint of pain. It is very well known that pain is an

early signature whether the tumor is extra or intramedullary and root symptoms predominate with neurilemmomas (1, 5). It is our belief that the patients with persistent radicular pain syndromes without any neurological deficit should be carefully examined with the non-invasive diagnostic methods such as CT and magnetic resonance imaging (MRI), since most of the patients harbouring a spinal neoplasm with this clinical picture do have benign and potentially curable lesions. With the routine use of MRI, these lesions will be much easily and precisely detected in a near future.

With the relatively small number of follow up examinations, it is rather difficult to draw a conclusion about the recurrence rates, especially of metastases, astrocytomas, ependymomas etc. It can only be stated that 23 cases of meningioma, neurilemmoma and neurofibroma that we could follow up responded excellently to surgical treatment.

As a conclusion, the authors would like to emphasize:

-Most of the tumors are benign in nature and their response to surgery is excellent

-Treatment carried out following the onset of the irreversible neurological deficit may be unsuccessful. Although the speed of progression of the lesions may dictate the prognosis, the classical rule of success is still valid: "The early the operation with less neurological deficit, the better the result".

-An unnegligible proportion of patients present pain syndromes with no neurological deficit. Every effort should be undertaken not to overlook this potentially advantageous patient group.

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PAEDIATRIC INTRASPINAL TUMORS

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MATERIAL:

Between 1965-1987 in the Neurosurgical Department of University of Ankara, 49 patients with paediatric spinal cord tumors were operated upon, in which the patients were less than 15 years of age. Of the 49 patients, 24 were boys and 25 were girls. By comparison this same group comprises 7.55% of all spinal neoplasms operated in our clinic at the same period. The ratio between spinal tumors of childhood and spinal tumor in general is 1:13.2 The frequency of intraspinal tumors increases in children above the eleventh year of age. The age distribution curves of our series is same.

Symptoms in our paediatric spinal tumor cases were as follows;

SYMPTOMS IN PAEDIATRIC SPINAL TUMORS

	Cases
Extremity Pain	18(36.73%)
Back Ache	28 (57.14%)
Weakness	42(85.71%)
Urinary Dysfunction	20(40.81%)

Signs in our cases were as follows;

SIGNS IN PAEDIATRIC SPINAL TUMORS

	Cases
Kyphoscoliosis	2(4.08%)
Reflex Changes	42(85.71%)
Gait Disturbances	36(73.46%)
Sensory Deficiency	34(69.36%)

Segmental distribution of paediatric spinal tumors were as follows;

SEGMENTAL DISTRIBUTION OF PAEDIATRIC SPINAL TUMORS

	Cases
Cervical	4(8.16%)
Cervicothoracic	4(8.16%)
Thoracic	20(40.81%)
Thoracolumbar	9(18.36%)
Lumbar	11(22.44%)
Lumbosacral	1(2.04%)

Site of these cases were as follows;

SITE OF PAEDIATRIC SPINAL TUMORS

	Cases
Dumbbell	2(4.08%)
Paraspinal	2(4.08%)
Intramedullary	12(24.48%)
Intradural	9(18.36%)
Epidural	24(48.97%)

These all 49 patients were treated surgically. In one patient decompressive laminectomy and biopsy was performed. In 20 cases, the tumors were removed. Subtotal and total removal was possible in 28 cases.

Comparison of the site of the tumor and type of the operation were as follows;

THE SITE OF THE TUMOR AND TYPE OF THE OPERATION

Site	TE	STE	B	Total
Intramedullary	9(%75)	2(%16.66)	1(%8.44)	12
Intradural	6(%66.66)	3(%33.33)	-	9
Epidural	10(%41.66)	14(%48.33)	-	24
Paraspinal	2(%100)	-	-	2
Dumbbell	1(%50)	1(%50)	-	2
Total	28(%57.14)	20(%40.91)	1(%2.04)	49

(TE: Total excision, STE: Subtotal excision, B: (Biopsy))

Pathological verification and site of tumors in our series were as follows;

PATHOLOGICAL VERIFICATION AND SITE OF TUMORS

	IM	ID	ED	DB	PS	Total
Astrocytomas	7	-	-	-	-	7
Ependymomas	-	1	-	-	-	1
Meningiomas	-	1	-	-	-	1
Neurofibromas	-	3	1	-	1	5
Epidermoid	4	1	-	-	-	5
Lipomas	-	-	1	1	-	2
Arachnoid cysts	-	1	1	-	-	2
Teratoma	-	-	-	-	1	1
Hemangiomas	-	-	3	-	-	3
Aneurysmal B.B.	-	-	2	-	-	2
E. myeloma	-	-	2	-	-	2
EM+E. sarcoma	-	-	1	-	-	1
Osteoma	-	-	1	-	-	1
Osteochondroma	-	-	1	-	-	1
Imm. Sarcoma	-	-	1	-	-	1
Lenfosarcoma	-	-	1	-	-	1
L.lenfoma	-	-	1	-	-	1
Burkitt lenfoma	-	-	1	-	-	1
Malign lenfoma	-	-	1	-	-	1
Hydatic cyst	-	1	-	-	-	1
Tbc. granuloma	1	-	1	-	-	2
Ossified fibroma	-	-	1	-	-	1
Fibroadipos mass	-	-	-	1	-	1
Metastatic	-	-	3	-	-	3
Non verified	-	1	1	-	-	2
Total	12	9	24	2	2	49

(IM: intramedullary, ID: intradural, ED: epidural, DB: dumbbell, PS: paraspinal, EM: endothelial myeloma)

Outcome of the patient were as follows; Excellent result was obtained in 12 patients (%13.48), and good result was obtained in 26(%53.06) cases. In 7 cases no change was seen and three case ended with poor results. One case died.

DISCUSSION:

The children with an intraspinal tumor usually present with weakness of one or more extremities, pain, or sphincter dysfunction. The incidence of neurological findings varies in most series. Richardson pointed out the importance of spinal rigidity as an early sign of intraspinal tumors. Haft, et al., reported gait abnormality in 24 of 30 patients, and found abnormal reflexes in 23 of their 30 patients. An alteration of gait was the most frequent symptom of these patients and should be stressed as a pertinent finding (1, 4, 6). We agree with Matson that much of the residual disability resulted from the prolonged delay before proper diagnosis was made, rather than from the effects of operation or from progression of the disease postoperatively. In the series of Arseni, et al., 30 of 42 patients presented with paralysis. In our series, 73.46% of the patients had paralysis when first seen (2, 10).

Spine roentgenography was abnormal in 62.22% of our patients. Changes in pedicle with or without widening of the spinal canal was the most frequent finding. Matson found abnormal spine radiography in 66% of his patients. The most frequent finding was pedicle changes; 31% had scoliosis (7, 8, 10).

In our series, myelography showed the lesion in 97.06% of the patients. De Sousa found abnormal myelogram in 67 of his 70 patients. Matson was able to determine an accurate level in 64 of his patients. Increased neurological dysfunction has been reported after myelography, and an emergency laminectomy may be considered following myelography on occasion. We observed no case with sudden neurological deterioration after myelography (3, 10).

The treatment of intraspinal tumors in children is surgical. Total removal should be considered in primary intraspinal tumors. As would be expected, patients in whom a total removal could be performed had a better chance for complete recovery, indicating a better prognosis for patients diagnosed and treated early. A total removal was possible in %57 of our patients.

We recommended radiotherapy to 7 astrocytoma cases. Matson stated that radiotherapy should be limited to tumors that are clearly inoperable (grade 3 and 4 astrocytomas). De Sousa suggested that a child with intramedullary astrocytoma should have a decompressive laminectomy with biopsy and/or myelotomy. According to DeSousa radiotherapy should be reserved for patients with progression of tumor growth after laminectomy (3, 9, 10).

The types of tumor encountered in our series do not differ from previous reports. Astrocytomas in our series were found to be 14.28%. Hamby found gliomas in 20% of his cases, Rand in 14%, and Matson in 23.5% cases (6, 10).

According to our experiments, we can conclude the results in paediatric spinal tumors as follows;

The incidence of intraspinal tumors in infancy and childhood (particularly gliomas) is probably greater than it is commonly accepted.

Suspicion of an intraspinal tumor in a child should be entertained as soon as the child complains of spinal pain and/or progressive spinal cord dysfunction and diagnostic certainty can be achieved with myelography and CT.

Radiotherapy may prolong survival, but its effectiveness from the point of view of neurologic restoration is not constant. Functional results are often satisfactory for gliomas, while they are much less favorable for extradural tumors. Results are better if the operation is carried out before the appearance of a total motor deficit, especially of flaccid type.

Long-term survival is much better for gliomas than for extradural tumors.

The complete removal of gliomas should be attempted whenever the anatomical and surgical conditions allow it, with more concern for the long-term than for the immediate result.

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CONGENITAL SPINAL CORD TUMORS

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Congenital spinal tumors may broadly be defined as spinal tumors present at birth. The term conventionally refers to a pathologically diverse group of lesions including dermoid and epidermoid cysts, neurenteric cysts, teratomatous cysts and teratomas, lipomas, chordomas and arachnoid cysts. As many congenital tumors inhabit the boundary between malformation and neoplasm, problems with categorization arise. Venous angiomas and spinal arteriovenous malformations, for example, are primarily malformations and are not included in this paper (1).

MATERIAL:

Between 1965-1987, in the Neurosurgical Department of University of Ankara 16 patients with Congenital Spinal Cord Tumors were operated upon. The patients range from 3-60 years of age at the time of diagnosis. The average age was 24 years. The 50% of our patients were between 10-20 years of age. Symptoms of congenital spinal tumors in our series were as follows;

SYMPTOMS IN CONGENITAL SPINAL TUMORS

	Cases
Weakness	13
Back Ache	8
Urinary Dysfunction	5
Lumbar Mass	3
Numbness	1
Impotence	1

On the neurologic examination of the patients; motor dysfunction with weakness was present in 14 patients. 11 patients had sensory loss and 9 patients had increased extremity reflexes. Myelography demonstrated a complete block in 10 patients and partial block in 4 patients. Congenital spinal tumors may be seen with other congenital abnormalities. In our series two patient had spina bifida and one had diastematomyelia. Segmental distribution of the cases were as follows;

SEGMENTAL DISTRIBUTION OF CONGENITAL SPINAL TUMORS

	Cases
Cervical	3
Thoracic	3
Thoracolumbar	4
Lumbar	6

The site of the 16 congenital spinal cord tumors were as follows;

THE SITE OF THE 16 CONGENITAL SPINAL CORD TUMORS

Intramedullary	6
Intradural	5
Extradural	4
Paraspinal	1

Type of the operation in 16 congenital tumors were as follows;

TYPE OF THE OPERATION IN 16 CONGENITAL SPINAL TUMOR

Total Excision	12
Subtotal Excision	4

Histological distribution of 16 congenital spinal tumors were as follows;

HISTOLOGICAL DISTRIBUTION OF 16 CONGENITAL SPINAL TUMORS

Epidermoid	6
Teratoma	3
Chordoma	3
Lipoma	2
Arachnoid Cyst	2

The results in our congenital spinal cord tumors series were as follows;

RESULTS IN 16 CONGENITAL SPINAL TUMORS

Excellent	8
Good	6
Poor	1
Exitus	1

DISCUSSION:

Congenital tumors are relatively rare and they constitute 18-30% of all paediatric spinal tumors. By comparison this group comprises only 2-3% of all adult spinal neoplasms. The dysgenetic syndromes, or phakomatoses, are associated with a variety of CNS tumors which may involve the spinal cord including neurofibromas and hemangioblastomas. Although there is a hereditary predisposition to tumor formation in affected patients, the tumors themselves arise from cellular metaplasia later in life. These lesions are therefore not truly congenital and not reviewed (1).

Dermoids, epidermoids and teratomas make up 1 to 2 percent of all spinal cord tumors. They occur predominantly in the lumbosacral area, involving the conus and cauda equina. They are usually associated with other congenital defects, but we couldn't detect any congenital defect in our cases. The treatment of these tumors is operative, optimal therapy being total resection. When removing a dermoid, an epidermoid tumor or a teratoma, the surgeon must take great care not to disseminate the tumor material, with the dual aim of not favoring the distant spread of tumor cells and not causing an aseptic meningitis due to diffusion of fatty acids and cholesterol into the subarachnoid spaces. In our series we had 6 epidermoid tumors and they were all totally exits, and aseptic meningitis was not detected in our patients, because we use irrigation with isotonic solution and continuous aspiration during the operation (2, 3, 4, 5, 6).

Adhesion of lipomas to the adjacent neural parenchyma is a well-known complication, and excessive removal of the mass may impair neurological function immediately after surgery due to intraoperative parenchymal injury. The main purpose of surgery for lipoma is not total removal but decompression of the adjacent neural structures. We had two lipomas in our series; one was totally removed the other subtotally. Despite the large size of many of these tumors, a complete block on myelography is rare but there was a complete block in our case (7, 9, 10).

Although most of the arachnoid cysts are usually localized extradurally, in our two cases, they were localized intradurally. Two-thirds of the adolescent patients with these cysts will present with kyphosis and in our series one patient had kyphosis (11, 12).

Chordomas usually occur at the end of the spine. About 40 to 50 percent of chordomas occur in the sacrococcygeal region. The incidence of distant metastases varies from 5 to 43 percent in the literature. We had 3 chordomas. One of them was in the cervical region and the others were in the lumbar region. We didn't detect distant metastases in our series (2, 8).

The spinal cord may host a wide variety of congenital tumors, the most common of which have been discussed. Although the majority of these lesions are benign their delayed diagnosis, serious infectious complications or associated congenital anomalies may expose the patient to life threatening morbidity or serious treatment may provide a cure in most instances, and the gratification of neurologically intact patients.

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SPINAL NEUROFIBROMAS

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Neurofibromas (NF) account for 23% of all spinal tumors. Treatment of NF's can be particularly attractive for surgeon because of their benign nature and highly successful results of their removal. The tumor has a special place in neurosurgery because the first intraspinal tumor removed was NF by Lecat in 1753. Although the surgery of the tumor has advanced enormously since then, NF's are still a worthy subject of study.

We are reporting on a series of 88 spinal NF's from the Ankara University Medical Faculty.

METHOD:

From 1965 to 1987, 88 patients at the Neurosurgery Clinic of Ankara University Med. School who had histologically confirmed spinal NF's were treated. This includes all cases of NF's that occurred below the foramen magnum.

SUMMARY OF CASES:

Fifty five of the patients were male and 33 were female and the average age at diagnosis was 52 years. The patients ranged from 11 to 70 years of age at the time of the diagnosis. The average duration of the symptoms was 18 months prior to the diagnosis. We accepted only those symptoms from the clinical history that seemed clearly related to the subject's subsequent course. A few patients had an onset as recently as 3 weeks before presentation but the majority had months or years of complaints, and a few were symptomatic for up to 2 years.

Symptoms: Motor weakness was the most frequent complaint in 75% of patients. Sensory loss constituted the only symptom in 57% of patients, their sensory loss most often characterized as radicular, corresponding in location to the root subsequently demonstrated to be involved by the tumor. 13% of patients complained of some form of bowel or bladder dysfunction and one third (33%) complained of radicular pain.

Sign: Only 4% of the patients had entirely normal neurological examination. The majority of neurological abnormalities related to some motor dysfunction. 78% of patients had sensory loss. Motor dysfunction with weakness was present in 86% of the patients. Bowel or bladder difficulties were present in 13.6%, 65% of patients had reflex changes.

Preoperative studies: Approximately one half of the patients had normal plain films. 51% abnormalities reported were pedicle erosions, enlarged foramina and several cases of erosion of the vertebral body and scoliosis. Myelography was performed in 98.86% of patients. Myelograms demonstrated a complete block in 71.26% of the patients and partial block in 27.58%. Computed tomography was performed only in one case. In three cervical NF's vertebral angiographic study was performed in order to determine the border of dumbbell NF's. When the schwannomas are situated in the cervical region vertebral angiography is valuable in defining the extent of the anterior and medial displacement of the vertebral artery by the tumor, since this may not be evident from the size of the enlarged intervertebral foramen (1, 2, 5). Analysis of the cerebrospinal fluid (CSF) showed an average protein value of 280 mg/100 ml. In patients with higher values of CSF protein, the fluid coagulated spontaneously.

Location: Most of the tumors were thoracic (43.1%) but they appeared to be roughly evenly distributed along the spinal canal with regard to the length of each area. 43% were thoracic, 17% lumbar. Most of the tumors were intradural (75 cases, 85%) and 5 (5.6%) were epidural. 14.77% were hourglass tumors. These also were distributed throughout the canal, 3 being cervical, 5 lumbar, 5 thoracic.

Operation: The optimal treatment of spinal NF's is total excision of the NF and then reclosure of the durameter. This was the procedure in our series and was accomplished in 73% of the cases. We prefer to operate on all cord tumors from the foramen magnum to the level of Th2, in the upright sitting position, with the use of a pinion headrest. Particular care was taken not to manipulate tumor against the spinal cord. In more recent cases, the operating microscope was routinely used. An effort was made to sacrifice only the roots directly involved in removing the tumor. For one stage removal of thoracic dumbbell tumors a curvilinear incision convex to the side of the extradural extension is required. This allows the surgeon to perform a costotransversectomy and rib resection, if needed to obtain extrapleural exposure, in addition to accomplishing a standard laminectomy. In dumbbell tumors a total foraminotomy may be necessary to expose the paravertebral portion of the mass.

General follow-up: Early results of operation in the 88 patients were available. Of these, 50 patients were better than preoperative status. 31 of the cases were unchanged. Five patients deteriorated and died. One of the mortalities was due to cervical cord manipulation and pulmonary arrest.

Complication: Five patients had worsened neurological functioning due to spinal cord manipulation. The remaining neurological deficits resulted directly from the sacrifice of involved roots in removing the NF. Often these roots were already nonfunctional and could not be further damaged. There were 6 CSF leakages. Two were treated by reoperation and 4 were treated by lumbar puncture. Two patients with cervical NF's died in postoperative period.

Surgical results: 44 patients (50%, were evaluated at the first postoperative follow-up. Over all 65% of the patients had full functional recovery after operation.

DISCUSSION:

NF's represent approximately 25% of primary spinal tumors. In our series spinal NF's constitute 13.55% of all spinal tumors. They arise from spinal nerve roots. Because of the relationship of intramedullary tumors to the nerve roots, they can, in their early stages, mimic disc disease and it is not a rarity of these tumors to be found after one or more surgical procedures have been directed toward the removal of protruded lumbar discs, only to have the patient continue to complain from unabated pain (4, 7, 8, 9).

Their involvement in the root often produces radicular pain and sensory changes. Tumors are generally solitary but sometimes multiple. NF's are usually intradural but can be extradural or both. Our series revealed 20% incidence of completely or partially extradural tumors. Another problem is the multiple NF. These are almost always signs of VonRecklinghausen's disease. Often removing all of them is impossible in such cases, surgery was probably planned to identify the symptomatic lesion. Malignant degeneration is most common in multiple lesions (3).

The standart technique is to incise the durameter on one side of the tumor and removing it without manipulation of the spinal cord. It is important not to manipulate the tumor back and forth in its bed. Sacrifice of the root is usually necessary, but attention should be paid to sparing adherent vessels and may provide an important blood supply to the spinal cord.

Plain spinal films are abnormal in half of the patients with NF's. Myelography of the entire spinal subarachnoid space is mandatory to rule out concealed tumors. Patients may improve through many months after removal of the tumor.

Postoperatively, for cervical tumors a periodic reexamination and X-Ray are mandatory. In the "virgin" cervical spine, removal of the median aspect of the facets and a wide laminectomy is usually an invitation to mechanical instability and subluxation.

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SCHWANNOMAS OF THE CAUDA EQUINA

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Primary tumors of the cauda equina are reported to comprise only six percent of all types of spinal tumors as a whole (6). Tumors of this region include ependymomas, metastases and lipomas, with the ependymomas being the most common type (1, 6). Although the vast majority are benign, the diagnosis of these tumors is often difficult and delayed due to their varied and subtle fashion of presentation (1).

MATERIAL AND METHOD:

From 1977 to 1987, eleven patients at the Neurosurgery clinic of Numune hospital, Ankara, who had histologically confirmed spinal schwannomas were treated. The age distribution, major complaints, the neurological signs during admittance, neuroradiological examination results, operative results, histological survey and follow-up examination findings were evaluated and the results, obtained.

RESULTS

Eight of the patients were women and three were men. The average age at admission was 37 years. The ages of the patients ranged from 22 to 56 at the time of diagnosis. The average duration of symptoms that seemed clearly related to the tumor was 28 months while the duration ranged from 5 months to 3 years.

Pain was the chief complaint, persisting in all of the cases. It constituted the only symptom in 63% of the patients. The pain was characterised as a low back pain in all patients while radicular pain radiating to leg was prominent in 72%. One third of the patients complained of weakness and 28% of bowel and bladder dysfunction. Four (36%) out of eleven patients have had physical therapy for several times before admission.

Only one (9%) patient had entirely normal neurological examination. Paraparesia was prominent in 4(36%) patients while motor weakness involving one extremity was detected in 2(17%). 64% of the patients had sensory loss. In 7(64%) cases, lower extremity reflexes were decreased while 27% had increased reflexes. Pathological reflexes were present in 2(18%) cases. Lasegue sign was found to be positive in 73% of the patients. Sphincter disturbance was found to be positive in 73% of the patients. Sphincter disturbance was detected in 3(27%) cases.

In roentgenological evaluation, only one patient was found to have compression at L3 vertebra, who has had a trauma previously. No pathological findings were prominent in the remaining cases at roentgenological investigation. On the other hand, myelography performed to all cases revealed complete block of the contrast medium. In one case, block was detected in two different levels L1-2 and L4-5. The block level was at T12 in one patient, at L1-2 in 5, at L2-3 in 2, L3-4 in one and L4-5 in 2. The case with a block at L4-5 level had also another lesion at L1-2 level.

All patients have undergone surgical intervention under standard prone position. Two or three laminectomies were performed according to the block level. In one patient, laminectomies were done at two different levels according to the myelographic findings. In all patients, intradurally localised tumors attached to the nerve root were removed completely. In the above mentioned patient, with two different levels of block, two tumors were removed in both levels. The histological investigation confirmed all specimens as schwannomas.

At follow-up examinations, no patient was found to have worsened neurological functioning due to the surgical intervention. 2(18%) patients remained the same as previously. Both patients had signs and symptoms of spinal compression with paraparesia and sphincter disturbances previously. No patients with previous motor weakness was found to be normal. 4(36%) of the cases had improved motor function. Paresthesias remained to some extent in all patients (64%) who had sensory disturbances previously. Persistent pain was reported in only 2(18%) patients while 5(46%) had a complete resolution. In the remaining 4(36%), a tolerable degree of back pain with sciatica was reported with physical activity. On the patients with preoperative bowel and bladder dysfunction (27%), none had improved.

DISCUSSION:

Schwannomas, together with meningiomas account for nearly half of all spinal neoplasms (1, 5). Although most of the schwannomas appear to be localised intradurally in the thoracic and cervical area, approximately 20% are found in the cauda equina (5). Our 11 cases comprise 7% of all spinal tumors treated during the same period in our hospital. The average age at admission was 37 years in our series which is in accordance with the age distribution of all spinal schwannomas reported in the literature (1, 3).

Caudal schwannomas in our series demonstrated a different sex predilection when compared to both tumors of other localisation and other pathologies of cauda equina. Male to female ratio is reported to be nearly same in other caudally localised tumors while in our cases this ratio was found to be one to three.

Whatever is the underlying pathology, the duration of symptoms of cauda equina lesions is apparently longer than other spinal tumors. Up to 5 years of duration is reported in encapsulated tumors of cauda equina. The average duration was 28 months in our cases. Besides having a slow rate of growth, the combination of signs and symptoms without any characteristic pattern result in failure of early correct diagnosis until irreversible neurological damage has occurred.

The signs and symptoms evidenced by caudal schwannomas do not follow a classic pattern of onset and evolution (4). The most frequent complaint is pain in the lumbar region or in the lower extremities according to the literature. The character of pain described by the patients is not different than of those suffering from lumbar spondylosis or a prolapsed intervertebral disc, leading to diagnostic errors. In addition, it is reported that in up to 90% of cases with caudal tumors, remissions and exacerbations occur during early stages. Also in our series, back pain with remissions was present in all cases while it constituted the only symptom in 63%. Moreover, 36% of our patients have received physical therapy previously.

Pain in recumbency is also reported to be a consisting symptom occurring in nearly half of the patients (6). It has been suggested that this is caused by either lengthening of the lumbosacral canal due to a decreased lumbar lordosis or by the ball-valve action of the tumor being forced down by periods of raised cerebrospinal fluid pressure during sleep. We have encountered with such a complaint in only 3(27%) of our patients.

By the time patients admitted to the neurosurgery clinics, there is usually a combination of signs sufficient enough to decide for further investigations. In our cases, only one patient was neurologically intact at admission. Although objective neurological findings are reported to represent at least 80% of the patients in most of the series, diagnostic errors are mostly made by attributing the symptoms to degenerative changes of the lumbar region. In our series, 4 (36%) patients had paraparesia as an indication of caudal compression while the rest except one had combined findings including Lasegue positivity, dermatomal sensory disturbances and diminished reflexes.

Unlike other localisations, plain radiographic abnormalities are unusual with the tumors of cauda equina (5, 6). Although widening of interpedicular distances and scalloping of the posterior surfacets of the vertebrae can occasionally be present, in any case myelographic visualisation of the intraspinal canal is mandatory. Myelography usually permits accurate determination of the localisation of the mass. Diagnostic errors are most frequently done when the attention is concentrated on the lower spinal canal, searching for a herniated disc or spondylosis. As it is observed in our series, most of the lesions are located above L3 level. 46% of our cases had myelographic block at L1-2, and 18% at L2-3 level.

The optimal treatment for caudal schwannoma is total excision and where complete macroscopic removal is possible, the recurrence is unusual. Although rare, it has been emphasized that major discrepancies may occur between the localisation of the tumor at myelography and surgery (2, 6, 8). The displacement of the tumor is attributed to positioning of the patient or shift due to injection of contrast medium. Whatever the cause, such tumors have considerable mobility possibly because they originate from a so-called redundant root. Although we have not encountered with such a case in our series, the possible mobility of the schwannomas should be kept in mind whenever the lesion is not found at the anticipated myelographic level. Surgical exploration should then include the whole length of cauda equina, if necessary (2).

The follow-up examinations disclosed that, the amount of residual neurological disability was directly related to the clinical presentation. Patients with severe neurological and bladder dysfunction remained the same after the surgical intervention while the best results are obtained in patients with slight or moderate neurological impairment. When the pain, the most consisting symptom during admittance is considered, in only 2(18%) cases surgical results were ungratifying while it subsided in the rest of the cases.

The most important point to emphasize is that although caudally localised schwannomas are rare, the difficult and delayed diagnosis due to the unfamiliar presentation of these tumors may result with serious neurological disability in spite of excellent surgical manipulations.

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CHORDOMAS

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Chordomas are rare tumors that arise from the rests of notochord cells along the spinal axis. Being a tumor of embryonic origin, chordomas also obey the general rule of being localized in the midline. They grow slowly producing local destruction of bone and frequently extent to the adjacent soft tissues (1, 8, 9, 10).

Chordomas represent less than one percent of all intracranial tumors and are seen generally between fourth to sixth decade. In literature, chordomas are reported as tumors slightly more common in males. For craniocervical chordomas, the male/female ratio shows no sex difference but the sacral chordomas are more common in males.

Histologically, chordomas are formed from large, vacuolated physaliferous cells. The vacuoles usually become very large that they compress the cytoplasm into narrow strands producing classic spider web appearance. They show small amount of mitotic figures and classified as benign tumors by the pathologists. But the clinical feature and the invading nature of the tumor makes it very hard to be resected and as it doesn't contain mitotic figures the tumor is strongly radio and chemotherapy resistant. The malignant nature of the chordomas lie in its critical locations, locally invasive nature and its extreme recurrence rate because of subtotal resectability.

MATERIAL AND METHOD:

11 cases of chordoma patients were admitted and undergone surgical intervention in Hacettepe University Medical School, Department of Neurosurgery during years 1967 and 1987. Data from the patients were evaluated according to their age and sex distribution, neuroradiologic examinations, clinical condition and neurological status at the admission to the hospital, localization of the pathologies, ways and types of surgical intervention and postoperative results and discussed throughout the literature.

REPORT OF CASES:

The patients are generally distributed in 20-50 years of age. The youngest patient was a ten years old girl and the oldest one was a sixty years old lady. There are 6 males and 5 females.

The leading complaint was back pain and headache (40%). Gait disturbance and urinary incontinence were the following complaints (30%). Lower cranial nerve palsies like disphonia and dysphagia according to clivus chordomas were only the complaints of 10%. The clinical course was a slow one. Except 3 patients, the duration of symptoms were more than six months. The neurological findings were reported in Table 1.

Direct X rays were taken for each patient. Destruction of the bony structures and increasing of the volume of soft tissues were observed in 60% of cases. In six patients, CT scannings revealed a low density mass invading the soft and bony structures. Myelography was performed for 6 patients and blocks due to the tumor were demonstrated successfully in all cases. In early years of our practice ventriculography was also performed to the patients having chordomas arising from the clival region and going down through foramen magnum to the cervical spinal chord showing ventricular dilatation due to the obstruction of SCF pathways.

Localization of chordomas are listed in table 2. Chordomas which originated in the lower clival region and going down through foramen magnum to the cervical spinal cord were included under the heading of clivus chordomas.

Surgical intervention was performed in all cases. For one clivus chordoma, the pterional route was chosen. Other two chordomas of this region, transoral route was the chosen one. None of the patients who had undergone transoral surgery needed tracheostomies. Suboccipital craniectomy and C1-2 laminectomies were performed to two foramen magnum chordomas. Lesions of the lower spinal chord were treated by laminectomy and radical tumor excision. All cases had undergone radiotherapy as an additive treatment. Radiation doses up to 8000 Rads were given in various centers.

We have one postoperative death. 59 years old male patient with a clivus chordoma died in 15th postoperative day, after having a pulmonary embolism revealed by pulmonary radionuclide scanning.

Eight patients had follow-up controls ranging from six months to seven years. Except one case the other patients were in good condition. This patient was a ten years old girl with a chordoma of the upper cervical region. In her last control 3 years after the operation, dysphagia, ataxia and dysphonia developed with tumor recurrence which was found to be inoperable.

DISCUSSION:

Chordomas are rare tumors which are derived from the notochord cells (8, 9, 10). In the literature they represent less than one percent of cranio-spinal tumors (1, 9, 10). In our 20 years' neurosurgical practice, we could operate only in eleven cases which also supports this finding. The male and female ratio

was reported on male's side. According to Sung et al. this ratio was 2:1 (6). C'ical et al. noted an equal male/female ratio (3). Our series also support this finding. But it shouldn't be forgotten that all of these series mentioned above contains only small amount of patients and their significance could be discussed. According to Rich et al. the chordomas are generally localized in the sacral region (5). In only two cases of our chordoma patients the tumor was localized in sacral region.

Chordomas are classified as benign tumors by the pathologists because of their non malign histologic appearance and lack of mitotic figures (2). Rich et al. (5) classifies chordomas in benign and malign forms according to their microscopic appearance. In the same article it is also shown that there was no correlation between cellular pleomorphism, mitotic figures or hyperchromatic nuclei and survival. Because of their localization and invasive nature it has always been a major problem to the surgeon and total removal was hardly reached. This nature of chordomas have a malign prognosis whether the tumor is benign in histopathologic appearance or not.

Chordomas are radio resistant tumors (1, 4, 5). According to Pearlman large doses in the range of 8000 Rads or more should be necessary to achieve long term survival. But it brings the serious radiation complications (4). In our cases 10 patients recieved radiotherapy after radical surgery. We recommend a radical surgery supported by a high dose radiation therapy.

TABLE 1: NEUROLOGICAL FINDINGS

	Number of Cases
Papilledema	3
Motor Deficits	3
Pathologic Reflexes	7
Cerebellar Dysfunction	3
Cranial Nerve Palsies	5
Hypesthesia	4
Normal Examination	1

TABLE 2: LOCALISATION

	Number of Cases
Clivus	3
Foramen Magnum	2
Cervical	3
Thoracal	1
Sacral	2

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FACTORS AFFECTING THE PROGNOSIS OF SPINAL EPANDYOMAS

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The new diagnostic technologies and the developments in microsurgery enabled neurosurgeons to make radical operations on spinal glial tumors. Whether there is not large series on the modern therapy of spinal glial tumors, the radical microsurgery is started to be considered as the way of therapy. 32 spinal epandymoma cases were admitted and had undergone surgical intervention between years 1970-1987 in Hacettepe University Medical School, Department of Neurosurgery.

In table 1, the age and sex distribution of cases are seen. 70% of cases were males and 30% were females. 65% of cases are gathered in 21-40 age group. Loss of power was the leading symptom in 81% of cases followed by midline backpain. The duration of symptoms of spinal epandymomas are usually very long (2, 3, 5, 6). In twenty nine cased series of Cooper and Epstein (2), this duration could go up to eight years. In our series, except loss of power, duration time of all symptoms are gathered in six months' period. In neurological examination of cases motor deficit was found in 94% and hyposthesia was detected in 59%.

In table 2, the motor grading system of this article is seen. Grade 0; patients having normal neurological examinations, grade 1; patients that can be mobilized without any help, grade 2; patients that cannot be mobilized without any help, grade 3; patients that move against gravity; grade 4; patients cannot move against gravity or totally plegic. 60% of our cases were in grade 1-2.

In 44% of direct X-rays an increase of interpedicular distance was observed, vertebral compression and intra canalicular calcification was not observed. Lumbar myelography was carried out in all patients. 91% of the myelographies revealed total block and 9% partial block. Epstein et al. (4), recommends a second day flouroscopy as a method to demonstrate the cystic components of spinal tumors. Cysts were observed in 7 cases of our series but the cysts couldn't be demonstrated in myelographies.

All of the cases in our series underwent surgical intervention. In 59% of cases the tumor was excised radically. In 41% of cases, the tumor could only be removed subtotally. In 59% of cases, the tumor was intramedullary localized, 37% extra and intramedullary and 4% extramedullary localized. 34% of cases were placed in the cervical and cervico-thoracal regions and 48% of cases were localized in lumbar regions.

The pre and postoperative results are summarized in the third table. We had 14 grade 0-1 preoperatively. Postoperative examination showed an increase of this grade in 20 patients. 2 patients died in the early postoperative period. Tracheostomies were performed to each patient and they died because of sepsis.

Our cases has follow up periods up to 7 years. As seen in Graphic 1 the follow up controls of grade 0-1-2 patients lasted longer. The 2 year survival-rate of grade 1-2 patients were 32% against the 0% survival rate of grade 3-4 patients. The localization of lesions and survival time is seen in graphic 2. Survival time of lumbar epandymomas were longer than cervical epandymoma patients against 5 controls for lumbar epandymoma patients in two years time. In this graphic, it is obviously seen that the radical removal has a two year survival rate of 32% against 0% of subtotal removal.

According to the results obtained from the evaluation of this series, the factors effecting the prognosis were the neurological condition at the admission, the localization of the tumor and the type of surgical excision.

TABLE 1: AGE AND SEX DISTRIBUTION OF CASES

	Male	Female	Total	%
0-10	13	2	2	4
11-20	3	2	5	16
21-30	7	2	9	27
31-40	8	4	12	38
41+	2	-	2	6
Total	22	10	32	100
%	70	30	100	

TABLE 2: MOTOR GRADING OF CASES

	Number of Cases	%
Grade 0	2	6
Grade 1	12	38
Grade 2	7	22
Grade 3	6	19
Grade 4	5	15
TOTAL	32	100

Grade 0: Normal

Grade 1: Mobilized without help

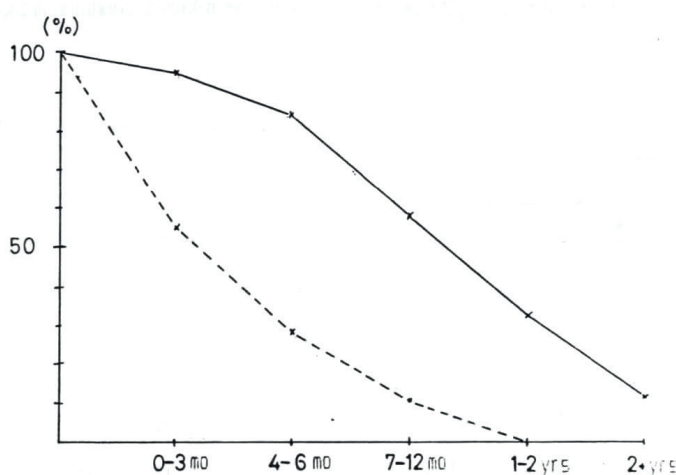
Grade 2: Mobilized with help

Grade 3: Move against gravity

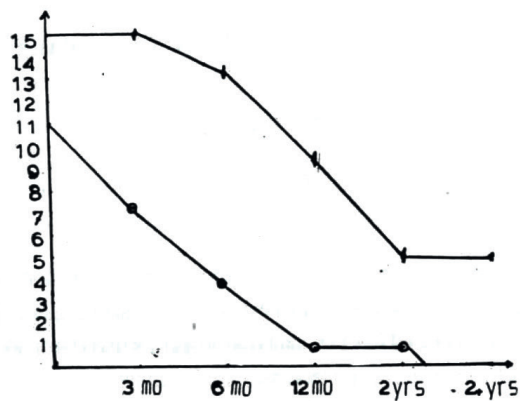
Grade 4: Cannot move against gravity or totally plegic.

TABLE 3: PRE AND POSTOPERATIVE MOTOR EXAMINATIONS

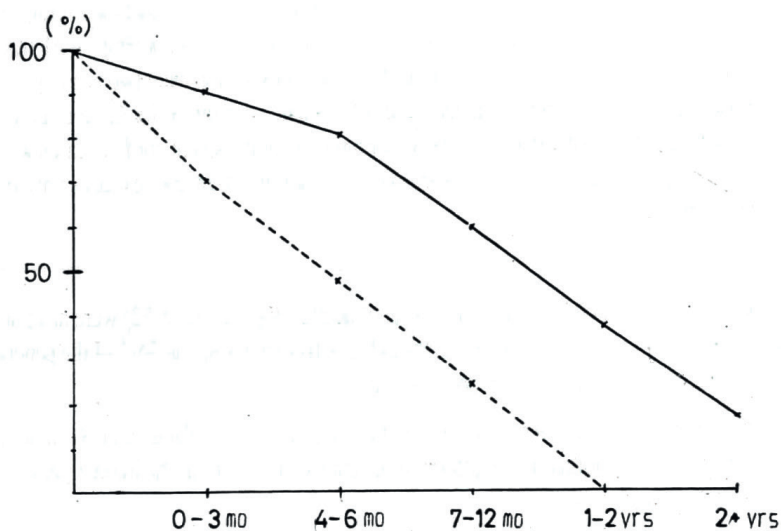
	Number of Cases		Number of Cases	
	(Preoperative)	%	(Postoperative)	%
Grade 0	2	6	10	31
Grade 1	12	38	10	31
Grade 2	7	22	7	22
Grade 3	6	19	3	9
Grade 4	5	15	-	-
Exitus	-	-	2	6
Total	32	100	32	100



Gr. I + II	95	84	58	32	11
Gr. III + IV	55	28	10	-	-



CERVICAL	7	4	1	1	0
LUMBAR	15	13	9	5	5



Total exc	90	80	59	37	16
Subtotal exc	70	47	24	-	-

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METASTATIC TUMORS OF THE SPINE AND SPINAL EXTRADURAL SPACE: A STUDY BASED ON 52 HISTOLOGICALLY VERIFIED CASES

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Compression of the spinal cord by epidural metastatic cancer is a common condition requiring early recognition and prompt treatment to avoid disabling paralysis (19). Nearly 5 to 10% of the patients with systemic cancer develop spinal extradural metastases (3, 10). In spite of grim prognosis of the basic disease, palliative treatment aimed at preserving or restoring spinal cord function (ambulation and continence) or alleviating intractable pain is warranted in many cases (4). Factors that influence the outcome in patients with spinal metastases are (a) tumor biology, (b) neurological status at the moment of treatment, (c) completeness of the myelographic block, (d) location of tumor within the spinal canal, (e) progression rate of symptoms, (f) general medical status of the patient and (g) therapy used (4, 5, 11, 21). For years, laminectomy was the only effective treatment for this problem. When effective radiotherapy became available the two modes of treatment combined. Subsequently, it was suggested that radiotherapy alone might be an effective means of treatment. Several retrospective studies indicated that the combination of laminectomy and radiotherapy was the most effective treatment for this problem. However, one prospective and some retrospective studies indicated no significant difference in outcome when radiotherapy alone was compared to the combination of laminectomy and radiotherapy (1, 3, 5, 6, 7, 10, 12, 15, 16, 17, 18, 20, 21). These studies show that the average rate of improvement obtained by operation is 30% (range 14 to 42%), by radiotherapy 46% (range 34 to 54%) and by operation plus radiotherapy 44% (range 36 to 61%). The difference between the first and two other types of therapy is significant ($p < 0.001$), but the difference between the latter two is not ($p > 0.4$) (2). According to these data, radiotherapy seems to be the preferred mode of treatment for spinal metastatic disease. Operation is reserved for (a) cases in which the nature of the spinal cord compression is unknown, (b) cases in which there is spinal instability or bone compression of the spinal cord, (c) cases with reactivation of the spinal lesion which can not receive additional radiotherapy, (d) cases with tumors known to be radioresistant and (e) cases presenting further clinical deterioration after radiotherapy. The issue is, however, controversial (2).

CLINICAL MATERIAL:

Of the 52 patients who form the basis for this report, 54% (28 out of 52) were followed until death. 23% (12 out of 52) were alive at the time these data were assembled. And 23% of patients were lost during follow up at different times after discharge from the hospital. 75% of the patients were males; ages ranged between 17 and 74 years. There was higher incidence in the fourth to sixth decades (Table 1).

Spinal metastases from mainly 6 different types of primary neoplasms were identified in this series as listed in Table 2. In 8 out of 52 cases the primary neoplasm was not known. As we will consider later, this is an important factor affecting our choice of surgery as the initial treatment. The site of spinal cord compression was the thoracic spine in 36 out of 52 cases.

Pain (central or root) was a complaint of every patient and usually was the first symptom often present several months before neurologic signs developed. The neurological status at the time of treatment was classified as follows: Grade 1, able to walk; Grade 2, capable of some movement but unable to walk; and Grade 3, complete functional cord transection (Table 3). Therapy success was defined according to two systems (Table A and B).

Plain x-ray films of the spinal column were performed in all cases. Myelography was carried out in some cases. This investigation is of great importance as it can reveal a metastatic lesion before bone changes appear on x-ray films (13). CT and CT-myelography were performed in 12 cases.

All cases underwent combined therapy (In principle, the therapeutic protocol required surgery to be followed by radiotherapy). The main aim of surgery was to decompress the spinal cord and nerve roots, not to attempt radical cure of the lesion; in many cases the opportunity of making a precise diagnosis at surgery was of primary importance. Surgery usually consisted of a wide laminectomy and removal of sufficient epidural tumor to relieve cord compression. Radiotherapy was commenced when the scar from the surgical wound had healed, usually about 10 days postoperatively. A total of 4500 rads was given in divided doses of 200 to 250 rads at a time, with four or five sessions per week. This was applied at the site of the lesion itself and to the vertebrae above and below the lesion.

RESULTS AND DISCUSSION:

The results were mainly analysed in relation to two factors; type of treatment and grading. Because of the limitations of the comparison of nonrandomised therapy groups, we selected the material to build homogeneous therapy groups with uniform distribution in the prognostic variables (pretherapy neurological status, incidence of radiosensitive tumors etc.) Following treatment 43% of patients improved in the short-term outcome (According to the grading system which is shown in Table B). The results obtained by combined therapy in two series is shown in Table 5. Our findings are similar or partly better than those achieved in recent series by radiotherapy alone (2, 8). Success rates obtained by combined therapy related to neurological status at the time of treatment are shown in Table 4 and 6 (According to the grading system which is shown in Table A). This analysis clearly shows that the preoperative condition influences the outcome of treatment.

Based on this series of patients we would like to stress on that; (1) the short-term outcome of treatment is clearly influenced by the severity of preoperative clinical manifestations (9, 14), (2) Whether radiotherapy alone might be the most effective treatment as recently suggested, avoiding the necessity of surgery is still controversial (10, 11, 14). It is essential that patients undergoing radiotherapy for spinal cord compression be followed closely by neurosurgeon. Meanwhile, several conditions must be met. Radiotherapy facilities should be readily available and adequate. Surgery, on the other hand, gives important advantages like that; (a) determining the tumor biology, (b) decompression of the spinal cord as much as possible and (c) preventing the clinical deterioration after radiotherapy. That is why, we recommend the use of combined treatment (surgery plus radiotherapy).

TABLE 1: SEX AND AGE DISTRIBUTION OF PATIENTS AT THE TIME OF SURGERY

Sex	
Male	39
Female	13
Age	No. of cases
11-20	1
21-30	5
31-40	4
41-50	17
51-60	17
61-70	5
71+	3

TABLE 2: PRIMARY SITE OF THE METASTATIC NEOPLASM

	No. of cases	%
Lung	8	15.3
Kidney	7	13.4
Prostate	5	9.6
Thyroid	3	5.7
Breast	2	3.8
Hematological	7	13.4
Other	12	23.0
Unknown	8	15.3

TABLE 3: THE NEUROLOGICAL STATUS OF PATIENTS AT THE TIME OF SURGERY

Grade	No. of patients	Preop. status
I	15(28.5%)	Ambulatory
II	22(43%)	Nonambulatory: Some motor function
III	15(28.5%)	Paraplegic: No motor function

TABLE 4: INFLUENCE OF PREOPERATIVE NEUROLOGIC DEFICIT ON POSTOPERATIVE RESULT

Preoperative function	Postoperative Result	
Ambulatory (15)	Ambulatory (14)	94%
	Nonambulatory (1)	6%
	Paraplegic (0)	0%
Nonambulatory (22)	Ambulatory (11)	50%
	Nonambulatory (9)	40%
	Paraplegic (2)	10%
Paraplegic (15)	Ambulatory (0)	0%
	Nonambulatory (5)	34%
	Paraplegic (10)	66%

(Figures in parantheses represent the number of cases in a category.)

Table 5: SHORT-TERM CLINICAL RESULTS ACCORDING TO MODE OF TREATMENT (S+RT)

Author	Total cases	Improved		Unchanged		Worse	
		No.	Percent	No.	Percent	No.	Percent
Constants et al.	465	215	46.24	192	41.29	58	12.47
Övül et al.	52	22	43	25	47.4	5	9.6

Table 6: RESULTS ACCORDING TO PREOPERATIVE NEUROLOGICAL GRADE

Author	Grade I		Grade II		Grade III	
	No. successes	%	No. successes	%	No successes	%
	no.cases	success	no.cases	success	no.cases	success
Barcena et al	(21/35)	60	(42/89)	47	(27/99)	27
Constant et al	(110/136)	80.9	(104/203)	51.23	(47/254)	18.5
Övül et al	(14/15)	94	(14/22)	63.6	(5/15)	33.3

The neurological status at the time of treatment is classified as follows: Grade I, able to walk; Grade II, capable of some movement but unable to walk; and grade III, complete functional cord transection. Therapy success is defined as the preservation or restoration of the patient's ability to walk with or without help within the 6 weeks of treatment. Patients were considered as "improved" if there was complete or partial regression of all clinical symptoms-pain and sensory, motor, and autonomic dysfunctions. Cases were classified as "unchanged" if the clinical status was not influenced by the treatment, and as "worse" if clinical manifestations progressed during treatment.

The results were considered in the short-term (that is, immediately after and in the first weeks following treatment), independently of the general course of the neoplastic disease.

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LYMPHOMA METASTASIS INVOLVING THE SPINAL CORD

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Lymphomas are one of the most common metastatic neoplasms involving the spinal cord extradurally. In an article written by Barron at all. 20 cases of lymphoma were detected between the 127 cases of metastatic involvement of spinal cord by various neoplasms extradurally. In another research which was performed in Massachusetts General Hospital, 89 metastatic cord involvements extradurally were analysed. This article included all age groups and 14 of these cases were lymphoma which was the most common neoplasm in this series. The subsequents were Ca. of the lung, breast, thyroid and prostate. In another analysis of metastatic neoplasms involving the cord was made at Hacettepe University, Neurosurgery Department and Lymphoma metastasis consisted 26% of all extradural neoplasms

MATERIAL AND METHOD:

In the period of 18 years between 1968-1986, 26 patients who were diagnosed hysto-pathologically were invested retrospectively by reviewing the clinical findings, laboratory and neuroradiological studies, surgical findings and post-operative long-term control examinations.

FINDINGS:

When we considered the sex and age distribution, we observed that 16 of the cases were males and 10 were females. Most of these patients were gathered in the first four decades of the life (19 of 26 cases were younger than 45 years old) (Table 1).

Except two cases, none of these patients had never been diagnosed before, as lymphoma primarily. The other two cases had been followed up and had been given chemotherapy for lymphoma for nearly one year before the cord metastasis were observed. The most common affected region was the thoracal spine and upper and lower portions were involved equally (Table 2). No sacral involvement was observed. The most common first complaint was back pain or radicular pain in these which is correlated with the results of many other analysis (80% in Barran's article, 77% in Wright's research). 21 of these 26 patients suffered from girdle pain, neckache or the pain spreading to the legs. The tumours affecting the thoracal spine usually result in girdle pain. Neckache or occipital headache in the upper cervical localized tumour and pain in the arms when the tumour presses the lower cervical roots are usually expected. In these patients spinal metastasis is usually not considered because that continuous back pain at the level of the lesion is nonspecific. That is the most important reason of missing the early diagnosis. Our results support this reality. The intervals between the onset of pain and diagnosis changed from two weeks to years (Table 3). Only sensory loss or motor weakness as a complaint were rare.

Most of these patients were paraparetic or almost completely paraplegic in their first examination. Except two of these patients, the others had sensory loss changing from mild paresthesia to anesthesia below the level of the lesion. The loss of sphincteric control of bladder was observed in 12 of these cases. The mechanism of motor dysfunction is probably the pressure on the longitudinal veins by the mass and this results in edema. Further compression or edema cause compression of the anterior spinal artery and radicular arteries resulting in ischemia and eventual infraction of the cord. Collapse of vertebral body causing compression of the anterior spinal artery may result in such ischemia. In Table 4, findings in the first neurological examination were detailed.

Complete blood count, serum electrolyts, hepato-renal function tests (SGOT, SGPT, Creatinin, B.U.N. ect.) were determined in all patients before or after surgery performed and in all of these cases further detailed investigations were done usually after surgery because the immediate neurosurgical approach had been necessary in some of these cases due to the serious and progressive neurological functional loss. In two cases bone marrow analysis showed lymphoma specifications and positive radionuclid scintigraphic findings of the liver and spleen had been observed like nonspecific hepatosplenomegalia or suggestive for lymphoma. Only in one patient inguinal lymph-node biopsy resulted in lymphoma.

The most frequent laboratory finding is the elevation of E.S.R. But it is possible in most of the neoplastic or infectious diseases and that is why it is not a specific and definitive finding for lymphomas (Table 8).

Unquestionably the most important and helpful studies especially for determining the acuteness of the neurosurgical approach are neuroradiological investigations. These are plain X-Ray studies, myelography, C.T. and M.R. image. Although plain X-Ray studies and myelography had been carried out in all cases, C.T. had been done in only a few M.R. images had never been taken because we don't already have this instrument. The suggestive plain X-Ray findings in these patients were lysis in vertebral body, destruction of pedicles and compression fractures. The frequency of these findings are shown in Table 5. Myelography also had been done in all of these cases and in 21 of these cases total or partial block was observed. In only 5 cases myelography revealed no significant findings. Unfortunately these were the cases of early years when we didn't have the C.T. facilities to show them. These five cases, although myelography didn't execute a clear pathological change, were operated on because of the serious neurological deficits which was probably due to the pressure on the epidural veins by the lesion causing edema and ischemia on the cord.

In recent years we are able to use C.T. routinely in these patients. C.T. studies are helpful in determining the existance of the mass involving the cord but

not in diagnosing the histological type. If the mass is nodular or multiple lytic lesions on vertebral body, these suggest lymphoma, multiple myeloma or vascular abnormalities to the physician (Table 5, 7).

In all these patients CSF analysis had been done and the only significant finding is the elevation of CSF protein content. This was observed in 14 cases and the values changed from 243 mg/dl to 3350 mg/dl (See Table 6).

THERAPY:

Total laminectomy and removing the mass totally or subtotally combined with radiotherapy and/or chemotherapy was performed in all cases. Radiotherapy with or without chemotherapy had been applied immediately after the histopathological diagnosis (Table 9).

RESULTS:

Follow-up informations of 17 cases for the first 6 months after surgery and of 12 cases for more than 6 months (led to seven years in some cases) were available. The other cases were missed due to the self factors of the patients.

Brice and Mac.Kissock defined the criteria to assess the severity of neurosurgical deficits to classify the results as satisfactory or unsatisfactory. According to these criteria patients were separated into 4 groups:

- 1) Mild: Patient able to walk
- 2) Moderate: Able to move legs but not against gravity.
- 3) Severe: Slight residual motor and sensory function
- 4) Complete: No motor, sensory or sphincteric function below the lesion.

Definition of a satisfactory result:

In this criterion the ability of walking and satisfactory control of bladder function over 6 months (maintained at least 6 months after surgery) are usually accepted as satisfactory. In a research which was performed at Whittington Hospital in London, A.S. Hall and N.N.S. Maccay declared that the results of 2 cases among the 8 Hodgkin's metastases and 4 of 5 lymphosarcoma cases were qualified as satisfactory.

In our series 1 of 4 Hodgkin's metastases and 9 of 13 lymphosarcoma metastases are qualified as satisfactory as considering by this classification. It should be noted that all these cases were given radiotherapy and/or chemotherapy besides surgical approach.

Results are below:

	Patients not well followed-up for the first month		Patients well followed-up	
		Satisfactory	Unsatisfactory	Total
Class 1	2	2	4	8
Class 2	2	1	4	7
Class 3	3	2	1	6
Class 4	2	2	1	5
TOTAL	9	7	10	26

The prognosis and the localisation of new metastases are showed in table 10 and 11. Remission more than 5 years was observed in 2 patients and nearly half of the well followed up patients had 2 or more years of survival time.

CONCLUSION:

These tumours are highly radiosensitive and well responsive to chemotherapy. If there is cord compression, surgical intervention is necessary and in these cases the benefits of laminectomy are

1. Removing the tumor as much as possible,
2. Removing the rigid wall of spinal cord and as a result of this, protecting the cord from edema, fracture, angulation of the spine and from compression of the tumor unless the mass could be removed sufficiently.

Finally we can say that it is possible to provide longer survival time by giving them radiotherapy, chemotherapy and performing surgery together. Long-term survival is more acceptable in extradural lymphoma metastases than other extradural metastatic neoplasms to the spinal cord.

TABLE 1: SEX AND AGE DISTRIBUTION OF CASES

Sex	Age:	18-24	25-34	35-44	45-54	55-64	65 andover
Male		4	5	2	1	1	3
Female		6	-	2	1	1	-
Total		10	5	4	2	2	3

TABLE 2: LOCALIZATION OF METASTASES:

Localization	Male	Female	Total
Cervical	6	2	8
Upper Thoracal	5	3	8
Lower Thoracal	5	3	8
Lumbar	-	2	2
Sacral	-	-	-

TABLE 3: FIRST SYMPTOMS AND INTERVAL BEFORE DIAGNOSIS

Symptoms	Interval				
	48 hours or less	48 h.-7 days	8-14 days	15-44 days	over 45 days
Back pain or radicular pain	-	-	-	8	13
Sensory loss	-	-	-	-	2
Motor weakness (Paresis or plegia)	-	1	-	2	-

TABLE 4: FINDINGS OF FIRST NEUROLOGICAL EXAMINATIONS OF PATIENTS

Clinical Findings	Number of Cases
Paraparesis	10
Paraplegia	6
Quadriparesis	4
Monoparesis	4
Bilateral paresis of upper extremities	2
Incontinence (Anal reflex) (Anal tonus)	12
Segmental Hypesthesia	6
Sensory Level (Hypesthesia under the lesion)	18
Without Sensory Loss	2
Pathological Reflexes	14
D.T.R. Hyperactive	14
D.T.R. Hypoactive	4
Muscle Atrophy	2
Tenderness of Vertebral Column	2

TABLE 5: FINDINGS ON PLAIN ROENTGENOGRAMS

	Number of Cases
Lysis in corpus vertebrae	7
Destruction in pedicles	8
Compression fracture	2
Foraminal enlargement	2
All cases had pathological signs on plain roentgenograms	19

TABLE 6: C.S.F. ANALYSIS

	Content	Range (Minimum to max.)	Number of Cases
Elevated	C.S.F. Protein	243-3350 mg/dl	14
Normal	C.S.F. Protein		12
Normal	C.S.F. Glucose		26
Normal	C.S.F. Chloride		26

TABLE 7: MYELOGRAPHIC FINDINGS

	Number of Cases
Total Block	15
Partial Block	6
Normal Findings	5

TABLE 8: LABORATORY FINDINGS:

	Number of Cases
Elevated E.S.R.	16
Decreased serum proteins	1
Pathological findings on radionuclid scintigraphy of the liver, spleen and kidney	5
Lymph node biopsy correlated with lymphoma	1
Mediastinal mass shadow on plain roentgenograms of the lung	2
Bone marrow analysis resulted as lymphoma	2

TABLE 9: METHODS OF TREATMENT

	Number of Cases
Surgery combined radiotherapy	12
Surgery combined chemotherapy	2
Surgery combined radiotherapy and chemotherapy	12

TABLE 10: PROGNOSIS (IN WELL-OBSERVED 12 PATIENTS AFTER SURGERY)

	Number of Cases
Metastasis or relaps in first 6 months after surgery	3
Metastasis or relaps between 6 months - 2 years after surgery	3
Metastasis or relaps between 2 - 5 years after surgery	4
Remission for 5 years or more after surgery	2

TABLE 11: LOCALIZATION OF POST-OPERATIVE METASTASIS

	Number of Cases
Gastrointestinal tract	6
Intracranial	2
Breast	1
Reccurens at the initial localisation	2

TABLE 12: SURGICAL RESULTS ON NEUROLOGICAL FINDINGS (SIX MONTHS AFTER SURGERY)

	Number of Cases
Worse	3
No change	4
Better (Partial improvement)	6
Complete improvement	4
Total	17

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SPINAL EXTRADURAL METASTASIS OF MEDULLOBLASTOMA

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Mr.Chairman, dear colleagues,

First of all I would like to summarize briefly two patients. 18 years old male was operated in December 1982 because of a posterior fossa mass which proved to be a medulloblastoma. The tumor was totally removed. Postoperative period was uneventful and the patient was irradiated. Outpatient serial control examinations were all normal until late in December 1985 when he complained of severe back pain and complete weakness of lower extremities. On examination he was totally paraplegic and hypoesthetic up to the level of L1.

Myelogram showed a complete block at the upper margin of T12 and another hold-up at the lower margin of L3 with only a small volume of contrast medium passing downwards. A control CT showed no recurrence.

The patient was operated and the tumor at the lower thoracic region had become epidural as a result of an intradural-extramedullary tumor which had infiltrated and pierced the dura. The lumbal tumor was totally epidural. Both tumors were removed totally and histopathologic diagnosis was medulloblastoma for both. The patient made a rapid recovery and was able to walk in the third postoperative week.

The second patient is also a male adolescent who was operated in October 1986 because of a mass located in the fourth ventricle. Total excision of the tumor was accomplished and the patient received craniospinal irradiation. 14 months postoperatively he complained of bilateral sciatica which has accentuated during the last month.

Myelogram disclosed a L4-5 block. Control CT showed no recurrence. He underwent L4 and L5 total laminectomy followed by total removal of an extradural tumor which was -like in the first case- as a result of an intradural - extramedullary tumor which has penetrated and pierced the dura. Histopathologic diagnosis was medulloblastoma.

Seeding of medulloblastoma to spinal cord or less frequently to the brain parenchyma by means of CSF is a well documented characteristic feature of this tumor. Practically all spinal metastases are intradural-extramedullary. Deutch and Reigel reported that 43% of their patients showed evidence of spinal cord metastases on postoperative myelography performed prior to radiotherapy. In the literature there is only one intramedullary seeding of medulloblastoma. Autopsy findings disclosed that more than half of the patients with medulloblastoma are found to have tumor spread through the subarachnoid space. On the other hand, metastases of medulloblastoma outside the central nervous system may occur and the probability of developing such metastases is about 5% although in one series 35% is reported. The factors playing a role in extraneural spread are not yet clearly understood.

Surgical intervention, radiotherapy, long survival-in recent publications five-year survival rate is over 70%-, shunt operations, especially when shunts lacking a cell-filtering device are inserted, and infiltration of posterior fossa dura have all been considered as factors contributing to extraneural spread. Relatively low rate of extraneural medulloblastoma metastases and the fact that nearly all patients harboring a medulloblastoma undergo surgery and receive radiotherapy has led us to think that these factors do not seem to associate with extraneural metastases. Main purpose of our presentation of these two cases is to comment on the strong possibility of tumoral penetration of the spinal dura eventually gaining access to extra dural space, therefore being a primary focus of systemic metastases. We have not encountered similar cases in the literature.

Our second purpose is to draw attention to the fact that spinal seeding in the absence of posterior fossa recurrence, which is the case for both of our patients, is rare.

Thirdly we would like to raise the question of when to perform myelography in patients with medulloblastoma. Dorwart and his friends have shown that 11% of their patients had spinal seeding when myelography was performed at the initial diagnosis of posterior fossa medulloblastoma and without any clinical evidence of spinal cord involvement.

In these patients the therapeutic tendency is additional spinal radiation to the demonstrated lesions. The percentage of spinal seeding rises to 33% when myelography was performed simultaneously with the first intracranial recurrence.

MANAGEMENT OF CERVICAL RADICULOPATHY

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(Experience with 52 cases)

Cervical disc disease have troubled human beings since the earliest recordings of human ailments. Cervical disc disease has been studied more extensively in recent years. Treatment was generally supportive and nonoperative until Sir Victor Horsley.

Sir Victor Horsley decompressed the cervical spinal cord of a patient with progressive cervical spondylotic myelopathy in 1901. The strongest confirmation of the identity of ventral chondromas or enchondromas and disc tissue came from Mixter, Barr and Kabick of Boston. In 1932 Mixter became the first surgeon to remove a preoperatively diagnosed ruptured intervertebral disc. In 1934 Mixter and Barr described four patients with cervical disc disease, three of whom were operated upon and benefited.

In the cervical, however, section of the normal scalenus anticus muscle continued because patients with hemiated cervical discs had been given erroneous diagnosis of scalenus anticus syndrome. Eventually, the syndromes of cervical root compression were defined and differentiation from myocardial ischemia with referred pain, brachial neuritis, thoracic outlet syndromes and neuropathy of the median nerve in carpal tunnel became even more certain. Aided by the new contrast material pantopaque, surgeons were able to diagnose an increasing number of cervical disc lesions (3). Acute cervical radiculopathy is usually due to herniated nucleus pulposus whereas chronic cervical radiculopathy is often the result of osteophyte formation (1, 2).

The lesions under discussion in this paper represents actual rupture of the anulus fibrosis of a cervical intervertebral disc with lateral extrusion of pieces of nucleus pulposus or cartilage that compress the various roots of the brachial plexus.

CLINICAL MATERIAL:

From 1965 to 1987, 52 patients at the Neurosurgery Clinic of Ankara University Medical School who had surgically confirmed soft cervical discs were treated.

22 of the patients were male and 30 were female. The patients ranged from 27 to 62 years of age at the time of the diagnosis.

Patients were selected as potential candidates for cervical discectomy if they had symptoms of cervical disease that include neck or radicular pain in one or both extremities after a strict conservative treatment, usually of a minimum of 3 to 4 weeks. Non operative treatment, usually of a minimum of 3 to 4 weeks, is directed at decompression of the root by traction and by measures to reduce the inflammation and edema. Failure of nonoperative treatment must be specifically defined and individualized. In the acute phase, if the pain is severe and if there is significant sensorimotor disability very early root decompression is indicated.

Pain was the most frequent complaint in 98% of patients. Motor weakness and sensory loss was the next frequent symptom (50%). At the time of admission to the hospital 41 (79%) of the patients had radiculopathy and 11 (21%) had myelopathy. Myelography was performed in 100% of patients and in all cases extradural defect consistent with a hemiated cervical disc was found. In one case CT was performed.

The lower cervical segments were mostly involved. In 24 (46.1%) of the patients C5-6 and in 22 (42.3%) patients C6-7 levels were the affected cervical segments. Four patients (7.6%) with C4-5, one (1.9%) patient with C3-4 and one patient (1.9%) with C7-Th1 discs were also diagnosed.

7(13.5%) cases were treated with anterior approach. 45(86.5%) patients were treated with posterior approach, with laminectomy. Selection of anterior versus posterior approach for the decompression of the root is to some extent the surgeon's choice. However for a pure radiculopathy of acute onset, we prefer a posterior approach.

Operative approach include total laminectomy in 18 cases, hemilaminectomy in 13 cases and partial laminectomy in 14 cases. For a posterior approach in a cervical operation, we prefer the sitting or prone position, what is the safest for the patient rather than what is convenient for the surgeon.

For posterior approach paraspinous muscles are stripped away from the laminae only on the appropriate side and held in place with a retractor. A small laminotomy is made laterally involving the inferior margin of the superior lamina and superior margin of the inferior lamina. There after the laminotomy can extend to the articulating facet (5, 6). After performing laminectomy we perform foraminotomy, with the aid of highspeed drill and microscope. With the root gently retracted, soft disc material is removed. In some cases we cut the duramater in a curvilinear fashion in order to remove disc material intradurally.

Occasionally the root is so attenuated over a bulging disc that to the naked eye it is indistinguishable from the anulus fibrosis. It is possible mistakenly to transect a portion of the root during the incision of the anulus under such circumstances. With the operating microscope however this distinction is quite clear because the margin of nerve root can be defined clearly.

Root retraction is minimized because of a better defined approach to the exposed portion of the disc herniation which is possible particularly with the use of microinstruments.

Late postoperative follow up could be achieved in 50 patients (2 months- 3 years). Among these, postoperative outcome of 29 patients (58%) were excellent and 19(38%) patients were in good neurological status, one patient was not improved and two patients were worsened. There was no mortality.

DISCUSSION:

Scoville and Whitecomb described five distinct categories of cervical disc lesions. They believe such categorization is mandatory if one is to approach the cervical spine lesions rationally (1, 2, 4). The 5 categories are as follows:

- a) The lateral soft disc
- b) The lateral arthritic "hard" or osteophytic disc
- c) The central "bar" or ridge discs
- d) The rare central "soft" disc
- e) Fracture dislocation with disc injury.

In almost 95% of the cases culminated from the literature, the disc lesions are lateral with the majority of those producing the classic acute monoradicular syndrome of soft discs (4).

In contrast to results of posterior approach for the compression of the compromised cervical spinal cord, results of anterior operations for relief of spinal root compression are uniformly favorable among authors and are excellent in duration. In 1965 Scoville quoted a 91% success rate in 702 cases. Both Knight and Spurling achieved similar results in their smaller series.

Murphy and coworkers reported on over 600 posterior operations for cervical root compression by rupture of the disc. They claimed excellent (100%) relief in 37.5% and 90% relief in 47.6% and stated that not a single patient received less than 50% relief (6).

From the foregoing research it appears appropriate to assure a patient with radiculopathy from a herniated disc, there is 90 to 95% probability of a highly satisfactory outcome and 2 to 5% risk of gaining less than satisfactory relief (4).

SUMMARY AND CONCLUSION:

1. Cervical monoradiculopathy occurs most commonly at C5-6 and C6-7. It is due mostly to acute herniation of nuclear material.
2. The syndrome often responds to conservative prescription but when surgery is indicated, the results are good.
3. The neurological examination is the most specific and sensitive clinical test.
4. Acute radiculopathies due to herniated nucleus pulposus are in our hands, best approached via posterior incision.
5. Chronic radiculopathies due to osteophyte formation may be approached either anteriorly or posteriorly.

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CERVICAL INTERVERTEBRAL DISC DISEASE

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Cervical disc disease and cervical spondylosis were known since the earliest years of medical practice. But the physiopathology of this syndrome was revealed in the first half of this century. Traumatic intervertebral disc herniations were observed by Virchow, Kocher, Wilkins and many other pathologists of the 19th century; however relation of the herniated nucleus pulposus and the clinical and pathological changes related to the lesion could only be described in 1934 by Mixter and Barr. Until 1901, when Sir Victor Horsley decompressed the cervical spinal cord of a patient with progressive cervical myelopathy by C6 laminectomy, the treatment was believed to be supportive and nonsurgical (5, 7, 12). Cervical disc disease has been studied till recent times and the changes in the spinal cord was attributed to different pathologies. Bailey, Gowers, Scoville and others recognized the degenerative effect of compression of the cervical cord or nerve roots by osteophytic protrusions into the spinal canal and root foramina (3). Brain, Frykholm and Gooding stressed the role of ischemia caused by the compression of the arteries and veins by the protruded disc or osteophytes as the major cause of the root and spinal cord degeneration (2, 3, 7). Kahn showed an early interest in the role of the dentate ligaments as Epstein and Davidoff had done (6). Barnes, Kaplan and Kennedy recognized the importance of abnormal joint mobility and intermittent cord compression by osteophytes during neck movements in the evolution of the cervical disc diseases (7, 9).

In 1952, Brain showed that the most common cause of progressive spinal cord and nerve root deterioration is chronic cervical disc degeneration. He also reported that the spinal cord is involved when the vertebral canal is narrow in the sagittal dimension (3). The same results were also found by Allen in his surgical observations, Payne and Spillane's neuropathological observations and Wolf et al.'s radiographic studies (1, 2, 4, 10).

Three ways for the surgical approach has been defined up to date (7). The first way is the posterior one which is based on the cervical laminectomy of Sir Victor Horsley in 1901. Scoville, Kahn, Fager and others modified Horsley's posterior decompression. Second way is the anterior approach to the compressive lesions developed by Robinson, Cloward and others (9, 12). In 1968, Verbiest introduced the anterolateral approach as a third way (7, 12).

Starting from the third decade of life, the water content of the nuclear portion of the cervical disc reduces. Elasticity of the disc diminishes causing the vertebral body to bear greater forces (7, 12). The articular cartilages of the vertebral endplates become subjected to greater stresses and the neck movements especially in extremes become less well tolerated. As a compensation of this increase of forces on the vertebral body, reactive osteophytes starts to form. The movement of the degenerated disc space reduces causing an increase of motion in the adjacent spaces. The osteophytes also stabilize the motion of the adjacent vertebrae whose mobility is increased by the degeneration of their common intervertebral disc. By the reduction of the elasticity of the intervertebral disc and the posterior longitudinal ligament, the compensation of the forces helping the nucleus pulposus to stabilize its position in the intervertebral space diminishes, forming a rupture in the posterior longitudinal ligament and causing the disc to herniate into the spinal canal, most often acute disc rupture occurs laterally within the spinal canal because of the relative weakness of the posterior longitudinal ligament over there. Consequently root compression in acute cervical disc herniation is more common than the spinal compression.

When a compression either by an acute disc protrusion or chronic disc degeneration and bony spur formation occurs, radicular arteries supplying the blood to the roots and cord become reduced sufficiently to compromise either root or cord function or both. Venous drainage of the spinal cord may be more compromised. The reduction of the venous flow increases the intravenous pressure that reduces the blood drainage from the cord, causing the serum to extravasate and form edema of the spinal cord. The edema increases the interstitial hydrostatic pressure causing reduction of the tissue perfusion and resulting cord and root degeneration (4, 7, 11, 12).

There are two main groups of cervical disc herniations. The first group is the acute cervical disc herniations and the second one is the chronic cervical disc herniations or spondylosis. Each group also divides into two subgroups according to the formation of myelopathy or not. The first group is generally seen in younger patients after a trauma and the second group is found in the patients over 50 years old (7, 8).

MATERIAL AND METHOD:

681 cases of cervical disc patients were admitted and undergone surgical intervention in Hacettepe University Medical School, Department of Neurosurgery during years 1965 and 1987. Data from the patients were evaluated according to their age and sex distribution, neuroradiologic examinations, clinical condition and neurological status at the admission to the hospital, localization of the pathologies, ways and types of surgical intervention and postoperative results are discussed through out the literature.

REPORT OF CASES:

The series is composed of 681 patients with ages ranging from 21 to 59. The youngest patient was a 21 years old male and the oldest one was a 59 years old female. 75% of all patients were gathered in third and fourth decade. 63% (424) of cases were male and 37% (257) were female. Mean age of the series was found to be 47.

Radicular pain, radiating down the arms was the leading symptom in 63% of patients at the admission to the hospital. Motor weakness of upper and lower extremities was the following symptom with a rate of 59%. Paresthesia (46%) was the third common complaint that was leading the patient to the physician.

Motor weakness had been found in 78% of patients. The motor system examination results and localization of the motor deficits were reported in Table 1. In 46% of patients the reduction or loss of upper extremity muscle jerks were detected. Signs caused by pyramidal tracts involvement were found in 61% of all cases.

Localization of one, two and three space disk herniations were summarized in Table 2a, 2b and 2c respectively.

Intraoperative findings revealed that 38% of cervical disks were soft and 62% were hard in nature. Ways of surgical intervention for soft and hard discs were reported in tables 3a and 3b respectively. 97% of soft discs and 60% of hard discs were excised by anterior approach. 27% of the anterior discectomies without fusion were performed to multiple leveled discs that were adding up to 139 patients with good to excellent results.

75% of cases with soft discs have excellent postoperative and follow up results. 4% of patients had no change of neurological deficits after surgical intervention and 3% of them had more severe neurological conditions in the postoperative period. Contrary to these very good results of soft disc surgery, only 35% of patients with hard discs had a total and 40% had a partial improvement after the operation. 13% of this group had no neurological change after the surgery.

We have two postoperative deaths. First case was a 52 years old male who died in the first postoperative day. A postmortem examination revealed massive pulmonary embolism. Second case was a 47 years old male with three level hard discs that were successfully removed. The patient could not awake from the anesthesia and his postoperative EEG controls revealed brain anoxia probably due to an anesthesia complication.

DISCUSSION:

In 1901, Sir Victor Horsley first made a posterior decompression for a cervical disc disease. Before that time cervical disc pathologies were treated non surgically. After Horsley's operation several ways of intervention were developed. Those operations were mainly using three routes. Posterior, anterior and antero-lateral ways. Each way has advantages and disadvantages. The advantages of anterior cervical approach can be summarized as:

- 1) The discs can be removed without any retraction to the spinal cord that can cause severe morbidity or even mortality.
- 2) Stability of the spine is better preserved.
- 3) If a postoperative haematoma develops, spinal cord compression is less likely than in a posterior approach.
- 4) Foraminotomy can easily be performed.
- 5) Positioning of the patient is more easy and has not the risk of air embolism that can occur in sitting position.
- 6) Postoperative mobilization of the patient takes shorter time that reduces postoperative immobilization complications.
- 7) Finally the operation can be directed to the cause of the disease and it is curative operation instead of a symptomatic posterior decompression.

Under the acquainted hands of a neurosurgeon, by the help of microsurgical techniques and operative microscope, the risks of poor visualization and possible damages to spinal cord during bone spur resection becomes minimum.

Cloward and Robinson described two slightly different ways for anterior discectomy with interbody fusion. Robinson's technique has a higher immediate stability while Cloward's technique has a greater accessibility for the removal of osteophytes. In 1960, Hirsch and his colleagues introduced their technique of anterior discectomy without a bone graft fusion (9, 12). Subsequent roentgenograms showed fusion of the adjacent vertebrae when time passes. By this technique, prolonged immobilization of the neck becomes unnecessary during the time when spontaneous fusion progresses.

In our series, 139 patient with multiple levels of cervical discs were operated by anterior discectomies without fusion. Pseudoarthrosis didn't develop in any of our patients. The results were excellent with the advantage of early mobilization.

TABLE 1: NEUROLOGICAL FINDINGS

	Nr. of Cases	%
Motor weakness	532	78
Sensory Deficit	418	61
Reflex Loss	312	46
Reflex Increase	419	61
Pathologic Reflex	272	40

TABLE 1a: THE MOTOR SYSTEM EXAMINATION

		Male		Female	
		Amount	%	Amount	%
1/5	MOTOR LOSS	159	28	106	20
2-3/5	MOTOR LOSS	90	17	122	23
4-5/5	MOTOR LOSS	53	10	10	2

TABLE 1b: LOCALIZATION OF MOTOR DEFICITS

	Number of Patients	%
One Arm	204	30
Two Arms	129	19
Quadriplegia	143	21
Hemiparesis	41	6

TABLE 2a: LOCALIZATION OF SINGLE DISCS.

	Male		Female		Total	
	Amount	%	Amount	%	Amount	%
C3-4	13	3	9	4	22	3
C4-5	30	7	17	6	47	7
C5-6	121	28	67	26	188	28
C6-7	72	17	43	17	115	17
C7-T1	0	0	4	2	4	1

TABLE 2b: LOCALIZATION OF TWO DISCS

	Male		Female		Total	
	Amount	%	Amount	%	Amount	%
C3-4/4-5	12	3	18	6	30	4
C4-5/5-6	31	7	33	11	64	9
C5-6/6-7	89	21	27	11	116	17
C6-7/C7-T1	7	2	9	4	11	2

TABLE 2c: LOCALIZATION OF THREE DISCS

	Male		Female		Total	
	Amount	%	Amount	%	Amount	%
C3-4/4-5/5-6	17	4	23	9	40	6
C4-5/5-6/6-7	25	6	3	1	28	4
C5-6/6-7/C7-T1	7	2	4	1	11	2

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CONSIDERATIONS ON 50 ANTERIOR CERVICAL DISCECTOMIES WITHOUT FUSION

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Since 1984 anterior discectomy without fusion for cervical discopathy has been adopted at the department of neurosurgery, SSK Hospital Mersin according to some technical modifications suggested by Horsch (6), Boldrey, Susen (9), Murphy Gado (8) Guarnaschelli and Caspar (2). For all cases we have employed the operating microscope.

The subject of this paper is the evaluation of the operations performed with this technique, particularly in relation to the sagittal diameter of the cervical spinal canal.

MATERIAL AND METHOD:

In the last 4 years 50 operations have been performed on 49 patients, whose age ranged from 21 to 65 years (average age 46,5) 34 were males, 16 females.

Preoperative clinical picture was pure radiculopathy in 32 cases, pure myelopathy in 7 cases and radicolomyelopathy in 11 cases. Two patients had been previously operated upon elsewhere, they underwent a posterior cervical discectomy and a cervical laminectomy. Myelography was performed in all of the cases and it was always consistent with the clinical picture. In 22 cases, all with findings of radiculopathy, one or several radicular pouches were found to be amputated, whilst in 28 cases transverse bars were evident at the level of one or more discs. 41 were operated on one discs, 7 on two discs and 2 on three discs.

The operating microscope was employed in all cases. The first day after the operation the patient was usually allowed to leave his bed, wearing a stiff cervical collar that he was instructed to wear two or three weeks, only while standing. In uncomplicated cases, the patient was discharged 6 or 7 days after the operation. All of the patients of this series have been examined at the time of discharge, after a month and later on, with an average follow-up period of 24 months.

RESULTS:

Intra-operative complications were: bleeding from epidural veins (2 cases), early postoperative complications are shown in Table 2; Shortly after the operation Homer's syndrome did not improve, dysphagia was transitory in 7 cases. Table 3 shows early and late operative results according to preoperative symptoms. The 50 patients of this series have been periodically followed as out-patient and the results of the follow up study has been classified as:

Excellent: Preoperative symptoms relieved, abnormal signs improved or abated,

Good: Minimum persistence of preoperative symptoms, abnormal signs unchanged or improved,

Poor: Symptoms and signs unchanged.

Bad: Preoperative symptoms unchanged or worsened, abnormal signs worsened and or appearance of new deficits.

The operations were successful in 44 cases (excellent and good results), in 3 cases it did not change the preoperative signs and symptoms (poor results), 3 patients became worse. Best results have been achieved in the group with a pure radiculopathy while most failures were found among patients with myelo-radiculopathy.

After the first 22 operations, a radiological control of the cervical spine in neutral position and in flexion-extension was performed, this control was repeated 4 and 15 months after the operation. A satisfactory alignment of the vertebral bodies with complete fusion between them was accomplished in the cases with the longest post-operative follow-up, where a mild asymptomatic spondylolysis was found. Dynamic films often showed reduction in flexion and extension movements of the operated interspaces, without any clinical relevance.

DISCUSSION:

Horsch (4) in 1958 adopted the anterior cervical discectomy without fusion. Boldrey (1), Susen (9), Murphy and Gado (6) Marting (5) reported good results using a similar technique. Robertson (7) and Caspar achieved better results with this procedure than with interbody fusion. The removal of the disc and of posterior and lateral osteophytes became easier after the introduction of the operating microscope, due to good light and magnification on. For this reason, at the department of Neurosurgery, SSK Hospital Mersin since 1984, most of the operations were performed with microsurgical technique, as recommended by others (3, 7)

The incidence and type of operative complications, the average postoperative hospitalization period and the percentage of excellent and good results in our series are comparable to the data reported by other authors.

Some of the worse, unexpected post-operative results provoked us to take into consideration the diameter of the cervical spinal canal as stated by Epstein et

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al. (2) "... the saggittal diameter of the canal ... normally is 13-18 mm as measured from the dorsal aspects of the C3-C7 segments to the white line indicating the junction of the laminae to from the spinous processes ... When a sagittal diameter of 13 mm is present, a borderline situation exists. Values less than 10 or 11 mm are important". All of our cases have been re-examined on the basis of this parameter.

In Table 5 we correlated the number of the patients and the operative failures to the sagittal diameter of the cervical canal. Out of 5 cases in whom it was less than 13 mm, two became worse, the incidence of failures is less relevant but nevertheless consistent in patients whose diameter measured between 13 and 14 mm (1 out of 7 became worse) while this incidence is lower when the diameter is normal. We believe that the most probable cause of the failures that we had among the patients we operated upon with a correct indication was the fact that we did not consider their narrow cervical spinal canal.

On patients with a cervical discopathy and stenosis of spinal canal, an anterior discectomy without fusion may be highly dangerous, in these cases we suggest to perform a decompressive laminectomy and, if the symptoms and signs are not relieved by this procedure, we perform later on an anterior discectomy with interbody bone graft to ensure the stability of the spine.

CONCLUSIONS:

Anterior cervical discectomy without fusion in cases of cervical radiculopathy and/or myelopathy offers good results without major complications provided that it is performed on correct clinical indication and in patients without a narrow cervical spinal canal. The microsurgical technique makes the procedure safer and more delicate.

TABLE 1: OPERATED LEVELS IN 50 OPERATIONS

Levels Operated	No.of	operations
Single		51
C3-4	2	
C4-5	4	
C5-6	14	
C6-7	18	
C7-D1	3	
Two		7
C3-4, C4-5	1	
C4-5, C5-6	2	
C5-6, C6-7	4	
Three		2
C4-5, C5-6, C6-7	1	
C5-6, C6-7, C7-D1	1	
Total		50

TABLE 2: EARLY OPERATIVE COMPLICATIONS OCCURRING IN 7 PATIENTS

Complication	Transitory	Permanent
Dysphagia	1	-
Homer's syndrome	4	1
Recurrent laryngeal palsy	1	-
Opposite radicular pain	1	-
Opposite radicular motor deficit	-	-
Worsening of myelopathy	-	-
Hemiparesis	-	-
Total	7	1

TABLE 3: IMMEDIATE AND LATE OPERATIVE RESULTS AS PER CLINICAL SYNDROME

	Operations	Excellent	Good	Poor	Bad	Death
Pure radiculopathy	32	13	17	1	1	-
Pure myelopathy	7	1	4	1	1	-
Radiculo-myelopathy	11	2	7	1	1	-

TABLE 4: RADIOLOGICAL FOLLOW-UP IN 22 CASES

Fusion	Complete 12
	Incomplet 10
Alignment	Normal 21
	Abnormal 1
Dynamic films	Normal 10
	Abnormal 10

TABLE 5: OPERATIVE FAILURES ACCORDING TO SAGITTAL DIAMETER OF CERVICAL SPINAL CANAL

Sagittal diameter	Cases	Bad results
Less than 13 mm.	5	2
Between 13-14 mm.	7	1
More than 14 mm.	38	-

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CERVICAL SPONDYLOTHIC MYELOPATHY

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Cervical spondylothic myelopathy (CSM) is the most serious consequence of cervical intervertebral disc degeneration, especially when associated with a narrow spinal canal due to laminar, dural, or ligamentous hypertrophy (8, 9, 10, 13). Since the early studies of the 19th century, the aetiology, pathogenesis, natural history and clinical spectrum have been well defined and even reproduced (7, 10, 13).

The characteristic clinical features of spondylothic myelopathy commonly include: gait disturbance, weakness and stiffness of the legs, spastic weakness of the upper extremities, impaired postural sensibility of the legs and various sensory disturbances of the arms (1, 2). On the other hand the term cervical spondylosis comprises all degenerative changes of the cervical spine. Spondylosis occurs particularly between C3 and C7, either at a single site, or more commonly, as a diffuse disorder (11, 14, 15).

The purpose of this report is to present the surgical results of CSM cases in the last five years with predominantly corticospinal dysfunction which were operated upon in Hacettepe University School of Medicine and to discuss the factors which effect the prognosis.

This series includes 44 cases. There were 10 women and 34 men, ranging in age from 32 to 72 years, with an average age of 54 years. The most frequent symptom at the admission included motor weakness in 36 cases, and paresthesia in 32 cases. The duration of symptoms varied from 20 days to 10 years, with an average of 4 years. Onset of symptoms was insidious in all and history of repeated minor trauma was forthcoming in only four cases. Preoperative neurological findings included the following: motor deficits 44 cases, reflex pathology 44 cases, spasticity 44 cases, clonus 44 cases and sensory deficits 40 cases.

EMG was performed in 34 cases, and in 31 patients there were pathologic findings. Cervical spine x-ray films confirmed osteophytic and degenerative changes and narrowing of the intervertebral space in all cases, and loss of cervical lordosis in 9 cases. 15 cases were interpreted as developmentally narrow canal. In this interpretation we use the criteria of Kodoya et al. (8) based on the lateral radiograph of the cervical spine: If the shortest distance from the center of the posterior surface of the vertebral body to the cortex of the internal surface of the spinous process was less than 12 mm. at the C5 vertebrae, a diagnosis of developmentally narrow canal was made.

Myelography was performed in all cases. 39 patients had filling defects, 3 had complete blocks and 2 had partial blocks. In 8 cases computerized tomography scans were obtained following myelography. In all cases there were centrally located disc material. In plain CT, the osteophytes and calcified discs are adequately visualized and canal dimensions measured with accuracy, but the cervical cord and roots cannot be properly assessed and the diagnosis of CSM cannot be ascertained. But the CT scan after myelography accurately determines the site and nature of spondylothic protrusions and provides good visualisation of the subarachnoid space and cord deformities even in areas with diluted contrast material (15).

The question of which surgical treatment of cervical spondylothic myelopathy is better is still controversial (3, 5, 7, 9, 12). However in the last years many series are reported in which the authors suggest that the anterior approach, in which the pathological discs are excised, particularly when osteophyctomy is included, offers results superior to those obtained with laminectomy (4, 6, 7, 13). In our series all the patients were operated upon. Operative data and overall outcome after surgery is shown in Table 1. Anterior discectomy was performed in 32 cases and a posterior approach in 10 cases. 34 of cases were improved and 9 were unimproved or frankly worse after surgery. The mortality rate is 2%. In this series there was a significant difference noted between cases undergoing anterior discectomy with or without fusion and posterior approach. Thus, anterior approach was clearly superior to the posterior approach.

Table II analyses results as they were effected by three clinical variables. Although patients older than 60 years tended to have unsatisfactory results, especially when compared to those less than 50 years old, no statistically significant difference was found. Similarly, an apparent tendency toward unsatisfactory results in patients with symptoms of more than one year duration was observed, but did not achieve statistical significance. Patients with severe neurological deficits preoperatively tended to have poor results; however, the severity of deficit proved to have no statistically significant relationship with outcome in this small series.

The retrospective study of our series results that, the clinical variables; age, symptom duration and severity of deficit had no effect on the outcome. On the other hand the surgical techniques had a significant effect on the clinical status of the myelopathy patients.

TABLE 1: EFFECT OF VARIOUS SURGICAL TECHNIQUES ON OUTCOME

Technique	Number of Cases	Outcome				
		Good	Fair	Unchanged	Worse	Exitus
1. Anterior Discectomy	32					
Two Levels	10	5	4	1	-	-
Three Levels	21	13	6	1	-	1
Four Levels	1	-	1	-	-	-
2. Anterior Discectomy						
With Fusion	2	1	-	1	-	-
3. Posterior Approach	10					
Laminectomy	2	-	-	1	1	-
Kahn Procedure	8	1	3	3	1	-
Total	44	20	14	7	2	1

TABLE 2: EFFECT OF THREE CLINICAL VARIABLES ON OUTCOME

Technique	Number of Cases	Outcome				
		Good	Fair	Unchanged	Worse	Exitus
AGE						
...50 Yrs.	10	6	3	1	-	-
51-60 Yrs.	26	13	9	2	1	1
61... Yrs.	8	1	2	4	1	-
Symptom Duration						
...90 Days	2	2	-	-	-	-
91-365 Days	9	3	4	2	-	-
365... Days	33	15	10	5	2	1
Severity of Deficit						
Mild	16	8	6	1	1	-
Moderate	19	10	5	2	1	1
Severe	9	2	3	4	-	-

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THORACIC DISC DISEASE

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Protrusion of thoracic intervertebral disc is an uncommon disease with unpredictable manifestations mimicking a wide variety of vertebral and medullary disease. Thus, the diagnosis of this lesion is notoriously difficult. Until recently plain X-rays and myelography were the most important tools for the diagnosis of this condition.

Recently better radiological techniques, especially CT, showing the extent of mechanical compression of spinal cord and new surgical approaches with few risks allow better management of such disorders (1, 4, 16, 17, 18).

MATERIAL AND METHOD:

Between the years 1966 and 1986, 3800 cases of disc operation have been performed in our department. 11 of them were at thoracic region, out of which 4 cases were treated during the last 2 years, after CT for spine was accessible in our hospital. The ages of our cases range between 19 and 62 and there was a male bias. In one out of our 11 cases herniation was located in middle, while in the rest they were in lower dorsal region. In 8 patients the pathology involved one level only. There were 2 patients with 2 level and one with 3 level herniation. Trauma was positive in 2 of our patients' past medical history. Numbness, pain and weakness in lower extremities, urinary retention and incontinence were the most common symptoms. Paraparesis and hypesthesia were the most prominent findings. Calcification of protruded disc space on plain x-ray and CT is seen in 5 of our series. We performed myelography for all and CT with or without intrathecal contrast enhancement for 4 cases. In 8 patient we performed laminectomy and discectomy, in 3 multiple level disc herniations only laminectomy was performed. Patients were followed up to 3 months or 1 year.

DISCUSSION:

Thoracic intervertebral disc protrusions make up only 0,3 percent of all disc protrusions (3, 13). The lower incidence of thoracic disc protrusion as compared with lumbar and cervical area has been attributed to the limited motion of the thoracic spine. The true incidence may be slightly higher with improved methods of diagnosis as pointed out by Haley and Perry revealing 2 thoracic disc herniations out of 99 specimens (6).

These lesions occur predominantly between the ages of 30 and 50, but also have been reported to occur in children (2,5). The condition seems to affect both sexes equally.

Disc protrusions between T9 and T12 account for approximately two thirds of the cases (1, 2). Several reports indicate that the eleventh is the single interspace most frequently involved. Herniations affecting middle and upper thoracic spine are quite rare, the latter being the least. Most herniations are single level but up to date 64 cases of thoracic disc herniations have been reported in the literature (3). The thoracic disc herniations can be divided into central and centrolateral subgroups according to its location (6).

Thoracic disc herniations, like disc herniations at other regions is a consequence of disc degeneration. Though, trauma sometimes seems to be an important precipitatory and aggravating factor, it appears to be only incidentally in most cases (1).

It is generally accepted that there is no typical clinical syndrome caused by protrusion of a thoracic intervertebral disc. If disc protrusion is mainly lateral or centrolateral, radicular type pain is the most common complaint. Central protrusion is associated with a high incidence of spinal cord compression and long tract signs. In the development of the neurological picture, 2 types of compressive effect occur: first being the vascular and the next being the mechanical (2).

In the thoracic region unlike the lumbar and cervical regions, the spinal canal is very narrow and consisting of minimal subarachnoid space and maximal cord volume and spinal roots have a very short intraspinal portion, therefore their contact with intervertebral disc is restricted to a distance of only a few millimeters. This particular anatomic feature determines the rarity of radicular pain in cases of central thoracic disc herniations (1). Pain in the back is caused by the distention of the annulus fibrosis and posterior longitudinal ligament (7, 11, 12). Prolapse of the thoracic disc does not happen all of a sudden, on the contrary, its evolution is rather slow. The chronicity of the process is demonstrated by calcification of the nucleus fibrosis, which appears frequently in the thoracic region and exceptionally in the other regions of the spine (1); however Julian reported an abrupt progression of this type of hernia (10). He attributed this rapid progression to the compression on Adamkiewicz artery. This artery is located between T9 and T12 in 75 percent of the population and is usually on the left side. Lesoin has reported a calcified protruded disc compressing the anterior spinal artery (11). The major complication of thoracic disc herniation is the vascular compression usually unforeseen and giving rise to important neurological deficits such as transverse medullary lesion. This factors have led to the extension of the indications for a surgical approach even for the patients suffering from minimum disc protrusion (11).

Since these lesions may mimic many other spinal diseases, precise radiological studies are of great importance. Up to present time, the definitive diagnostic procedure for thoracic disc protrusion has been the myelogram. Due to the difficulty of pooling the contrast material in the thoracic region, the

study is hardly complete but should include good quality lateral films in prone position since these will usually reveal the true location of the defect in the anterior extradural space behind the disc. (17).

Recently CT has been used to demonstrate these lesions even in cases in which myelography was not all that helpful (1, 7,18). With non-enhanced spinal CT, the contrast difference between the epidural fat and the disc material is of great help in the diagnosis in lumbar region. On the other hand in thoracic region, since epidural fat volume is minimal, this aspect does not contribute to the diagnosis (11). Especially with intrathecal contrast material enhancement, CT accurately demonstrates the disc herniation, generally showing an obliterated subarachnoid space and compression and displacement of the spinal cord (8).

MRI is also very efficient in the diagnosis of thoracic disc disease. It has been reported that the most helpful feature in MR imaging is the bright intensity of CSF which allows an excellent visualisation of the borders of the disc protrusion (19, 20).

Laminectomy plus extradural or less frequently intradural removal of the disc and occasionally only decompressive laminectomy has been the choice of treatment of thoracic disc disease. When the results were reviewed, particularly midline hard disc protrusion causing spinal cord compression with severe neurological deficit was only made worse (17). These results have served as a stimulus for the development of alternative approaches for these devastating lesions. In 1960, Hulme utilized a lateral costotransversectomy approach for these lesions (9). Later, transthoracic approach was used by Perot and Rosnohof for the removal of a midline thoracic disc protrusion (17, 18). Although transthoracic transpleural approach can provide access to the vertebral bodies and intervertebral space from T2 to T12, it is most suitable for exposing the midthoracic region because exposure is obtained with difficulty at the most rostral and caudal interspaces (16). Using a transthoracic transpleural technique a risk of overlooking a fragment of disc embedded within the dura exists just because of this exposure problem. Besides this, there may be some risk to the circulation of the spinal cord if an intercostal artery is sacrificed (1, 11, 17). The posterolateral approach gives better access to the spinal canal than the transthoracic one, but there is still the risk of vascular complication (7, 11).

In 1978, Petterson and Arbit described a new approach through the pedicle (16). The spine is exposed through a midline incision and the paravertebral muscles are reflected on one side for enough exposure of the facet joint. The facets and the pedicle of the vertebra caudal to the disc are removed with rongeurs and air drill. This exposes the disc space. The interspace is entered and disc material is removed working from the side, in front of the root and also the dural sac, without touching them. If laminectomy seems necessary, it is easy to carry out after the cord has been decompressed anteriorly.

Seven out of eleven of our cases were diagnosed by myelogram in the pre-CT era to rule out epidural compression of any kind. In post -CT era 2 out of 4 did exhibit multiple level lesions and just because of a slight possibility of either the calcification of posterior longitudinal ligament or a epidural metastatic neoplasm, they underwent laminectomy.

As pointed by Lesoin the disadvantage of pediculectomy technique is the spine instability despite the support provided by the thorax. A short unilateral Harrington rod should be applied to prevent bending and subsequent deterioration through ischemia. Pediculectomy for multiple level disc protrusion creates severe instability of the spine. In our series the outcome of the surgical treatment with laminectomy for multiple level disc protrusion was found to be good. As a conclusion in multiple thoracic disc disease the treatment of choice may be either a very meticulous laminectomy with highspeed air drill or pediculectomy + Harrington rod.

Apart from the operative technique the location of protrusion and preoperative neurological state of the patient are important factors contributing to the outcome of surgical treatment, the most favourable results belonging to centrolateral or lateral protrusions especially in lower thoracic region and in patients presenting with minimal neurological deficit (1, 17).

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MULTIPLANAR CT EXAMINATION OF THE CRANIOVERTEBRAL JUNCTION

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The craniovertebral junction is a complex anatomical region. Diverse pathological processes produce a perplexing clinical picture and diagnosis is often not simple. The advent of CT has greatly simplified the radiologic evaluation of this region, since CT can demonstrate both bony elements and the neural tissues. In order to display the very complex spatial relationship of the craniovertebral junction we have performed direct CT examinations in three different planes.

MATERIAL AND METHOD:

This study includes 30 patients with diverse craniovertebral pathologies which could be diagnosed by multiplanar CT examination.

The first CT examination was performed in the transaxial plane with 3 mm slice thickness, beginning at the lower end of C2 and ending at the 4th Ventricül level. In all patients with normal sized spinal canal, a direct coronal CT examination could be performed. For the direct coronal CT examination the patient was seated in the gantry leaning the back of his head slightly on a head-rest. The direct sagittal CT examination was performed on the prone lying patient with the head laterally flexed. On the other hand if the spinal canal was narrowed we have performed further CT examinations with intrathecal contrast medium in order to display the spinal cord.

All lines and angles which are substantial for the radiologic diagnosis could be measured on these CT scans. The basilar line, Klaus's index, Chamberlain's line, McGregor's line, Bull's Angle can be determined on the direct sagittal scans, bimaistoid and bidigastric lines can be drawn on the direct coronal scans (1).

RESULTS:

Etiologically, the patients were classified under 4 groups (Table 1). 16 patients were grouped under acquired or congenital malformations. Axial, coronal and sagittal CT examinations could be easily applied to this group. In the cases of mucopolysaccharidoses and isolated dens hypoplasia the spinal canal was narrowed and because of atlantoaxial dislocation only axial examinations could be performed. In the Arnold Chiari Type II Syndrome patients were under 1 year of age and sagittal examination could not be applied.

Table II displays the CT findings in the malformation group of patients.

In 2 patients with torticollis, rotatory dislocation at the C1-C2 level could be diagnosed by coronal CT examination. Patients with acute trauma were examined in the axial plane, in cases of dens fracture or narrowing of the spinal canal no further examinations was carried out. Patients with old trauma could be examined in the coronal plane. The patients in the torticollis and tumor group could also be easily examined in all 3 planes with CT.

DISCUSSION:

The radiologic investigation of the craniovertebral junction using conventional methods is usually difficult. CT can display the bony elements and soft tissues simultaneously and it is easier to perform than many other classical radiologic methods. 21 direct sagittal, 22 direct coronal and 30 transaxial CT examinations were done to 30 patients without any complication during or after the study. Coronal and sagittal examinations could not be applied to infants. In case of acute trauma or narrowing of the spinal canal, sagittal and coronal examinations were omitted. Sagittal CT scans were ideal to display the occipitalization of the atlas, the anterior basilar invagination and the antero-posterior atlanto-axial dislocation. Dens hypoplasia, basilar invagination, condyl dislocations and atlanto-axial dislocations could be demonstrated on coronal CT scans. Rotatory atlanto-axial dislocation, narrowing of the foramen magnum and dens fractures could be diagnosed on axial CT scans. A certain plane of CT examination is not superior to others, but each plane of CT examination has a special diagnostic implication. A radiologic diagnosis could be supplied by CT for each of our 30 patients and no further radiologic examination was necessary. Multiplanar CT examination is a practical and informative method to investigate the crani-overtebral junction.

TABLE 1:

Etiological Distribution of 30 cases	MALFORMATIONS Cleido-cranial dysostosis (1) Mucopolysaccharidosis (1) Arnold Chiari II. (6) Achondroplasy (1) Apert-syndrom (1) Wilderwanck Sendrom (1) Klippel Feil (1) Dens hypoplasia (1) Ant. Basilar Invagination (1) Vertebralization of the occiput (1) Occipitilisation of the atlas (1)	TRAUMA Dens Fracture (3) Atlanto-axial dislocation Condyl Fracture Rotatory dislocation (2) Basilar Process Fracture. Condyl dislocation (2)	TORTICOLLIS Rotatory dislocation(2)	TUMOR Chordoma Menerioma
Transaxial CT	16	10	2	2
Direct Coronal CT	12	6	2	2
Direct Sagittal CT	12	6	2	1
Myelo CT Transaxial	4	0	0	1

TABLE II:

RADIOLOGIC DIAGNOSIS BY MULTIPLANAR CT EXAMINATION

Malformation Group	Mucopolysaccharidosis
Dens Hypoplasia	Convexo-basia
Cleido-cranial Dysostosis	Small Foraman Magnum
Achondroplasia	Dens Hypoplasia
Apert Syndrom	Normal Cranio-vertebral Junction
Wilderwanch Syndr.	Normal Cranio-vertebral Junction
Klippel Feil	Dens Hypoplasia.
Isolated Dens Hypoplasia	Isolated Basilar invagination
Isolated Basilar Invag.	
Trauma Group (10 Patients)	Dens Fracture 3 cases Atlanto-axial dislocation 1 case Condyl Fracture 1 case Rotatory dislocation 2 cases Basilar process fracture Condyl Dislocation 2
Torticollis group (2 Patients)	Rotatory Dislocation
Tumor Group	Menengioma, Chordoma Enhanced mass in the medullary cistem. Bone destruction of the basilar process and mass in the prepontin cistem.

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ARTERIOVENOUS MALFORMATIONS OF SPINAL CORD

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Arteriovenous malformations of spinal cord are uncommon, they comprise (4%) of all spinal cord tumours. Between 1965-1987, eighteen cases with spinal cord arteriovenous malformations were treated at Hacettepe University Department of Neurosurgery. They are three times more common in men than women. All of the patients were admitted with progressive neurological deterioration. In three patients catastrophic onset of neurological abnormalities with SAH were seen. In all of our patients the myelogram provided information about the extent of the AVM. Spinal angiography was performed in 13 of 18 patients and we have been able to show the arterial supply in three patients.

Treatment was surgical, preferably the total excision of the malformation. The neurological status of eight patients was unchanged from their preoperative condition. In six patients excellent results were obtained and two patients continued to deteriorate after the operation.

Arteriovenous malformations of spinal cord are relatively rare (1). Early classification of spinal cord AVM's relied upon descriptive pathological analysis (2). The development of selective spinal arteriography in early 1960's allowed precise assesment of radiographic anatomy of these lesions and their subsequent classification into juvenile, glomus and single-coiled vessel malformation. The long dorsal lesion are usually extramedullary and lie on the dorsal surface of spinal cord, displaying slow flow and relatively low intravascular pressure (3, 4).

Sixteen long dorsal AVM's were operated on and the other two cases were performed selective spinal embolization at Hacettepe University Department of Neurosurgery between the years of 1965 and 1987.

The purpose of this paper is to present these cases and to review the literature.

MATERIAL AND MEDHOD:

The files, neurological examinations of the patients have been reviewed and compared with the current publications.

RESULTS:

All of the patients had intradural AVM's. These AVM's were divided into glomus type in two and single-coiled vessel in sixteen. There was male predominance. Thirteen of them were men. The age of the patients with symptoms ranged from 17 to 55 years. ($34 \pm 11,9$) (Mean \pm standart deviation) Two patients were under twenty years of age.

The initial symptoms in patients with spinal AVM was most frequently paresis which ocured all of them and nine patient had disturbance of micturition. Subarachnoid hemorrhage was responsible for the initial symptoms in three cases.

The results of neurological examinations are shown in table 3. Spastic paresis of lower extremities were found in eighteen casès and loss of the sensations of the pain and temperature in fifteen cases. A distinct sensory level was present in most patients. The level generally reflected the location of the vascular nidus of the AVM along the spinal axis.

Neuroradiological examination findings are summarized in Table 5. Routine x-ray examinations performed in all cases. Except one, the others were normal. Myelography was performed in sixteen cases (Table 6). In thirteen of them, myelography was performed with Myodil and two of them with Omnipaque. Because Myodil made the spinal canal dirty, the findings of angiography became obscure. Myelography demonstrated total block in two cases and irregular narrowing in fourteen cases.

Selective spinal arteriography was performed in thirteen cases (Table 7). In nine cases of them, there were not seen any blushing related to the spinal AVM. Four of them were indicated blushing. The feeding vessels originated in lower thoracic and upper lumbar region in two of them. One case had two feeding vessels and it was seated in the middle thoracic region. The other one had four feeding vessels at the lower thoracic level. The direction of venous drainage was rostral. The dilated tortuous veins were always evident on the dorsal surface of the cord.

Surgery was performed on sixteen of eighteen patients. The types of surgery are demonstrated in Table 8. An emergent decompressive laminectomy was performed in one case. Nidus coagulation was performed in three cases. The epidural vessels were coagulated with bipolar forceps and transected. Both the extradural vessels and a segment of the paramedullary coiled vessel were removed in twelve cases. Following surgery, six patient improved and eight remained stable.

DISCUSSION:

Arteriovenous malformations of spinal cord represent three to four percent of spinal cord masses (1).

Spinal AVM's are frequently found in middle-aged people. The duration of symptoms were generally slow. In the present report the age of the patients

ranged from 17 to 55 years (34±11,9) (mean±standart deviation). Males comprise 63% of the cases. These findings were the same as previously published data (5).

All of our cases had paraparesis. One of our patients admitted three times with SAH. At the third admission, the cause was found as a spinal AVM. Another case, for whom, a surgical intervention had been performed for lumbar disc hernia three years before; had embolization for an AVM located at the thoracic region. Another case had followed as multiple sclerosis for two years in another center. Pia (2) states 12% for misdiagnosis.

Spinal AVM's are generally located at the posterior surface of the spinal cord (6). For this reason myelography must be performed in supine positions. In the present report, six cases had surgical intervention only with the aid of myelography. Spinal arteriographies are very important in the spinal AVM's in order to see the feeding vessel, diameter of the lesion and to study flow rate characteristics. In the present report spinal arteriography was performed in thirteen patients. The feeding vessel can be seen in four patients. In the literature this was reported as 80% (4). This is because of the failure of magnification and subtraction techniques in our cases. In only one case subtraction and magnification was performed. In twelve patients lesions were removed totally. Three patients improved. Seven patients were unchanged and two patients were worsened. Reviews have shown that decompression alone or ligation of feeding arteries leads to less than satisfactory results (1, 5).

Yaşargil (5) pointed out that 33 of 41 cases with spinal AVM were removed totally, eighteen showed an improvement in their postoperative neurological state, seven were unchanged and five were deteriorated. Rosenblum and Di Chiro suggested that following surgery on 43 operative patients, the neurological status unchanged in 22, improved in 14 and worsened in six.

Spinal arteriography was not performed postoperatively. Lussenhop and Dela Cruz (8) and Houdart (9) emphasized in a review of the surgery that, the importance of pre and postoperative spinal arteriography and noted that one fourth of their lesions had intra and extramedullary components.

Embolization was carried out in two patients and this procedures shut up all feeding vessels.

We suggested that in cases of dural or single coil AVM's ligation procedures must be done. Because good results were acquired in the postoperative period.

TABLE 1: ONSET OF SYMPTOMS

Ages	No of Cases
1-10	-
11-20	3
21-30	4
31-40	6
41-50	3
51-60	2
61-70	-
Total	18

TABLE 2: SYMPTOMS

	No of Cases
Headache	3
Vertigo, Vomiting	3
Backpain	6
Paresis	14
Numbness	3
Urinary Incontinence	9
Faecal Incontinence	4
Impotence	2

TABLE 3: FINDINGS

No of Cases
Paresis and Paralysis 18
Sensory Loss 15
Hyperreflexia 6
Hyporeflexia 7
Babinsky 6
Cremasteric Reflexes Loss 2
Abdominal Reflexes Loss 4
Hypotonic Anal Tonus 4

TABLE 4: LOCALIZATION OF THE VASCULAR NIDUS

C2-4 1
C5-7 1
T1-3 3
T4-6 2
T7-9 4
T10-12 5
L1-3 2
Total 18

TABLE 5: PLAIN X-RAY FINDINGS

No of Cases
Pathologic 1
Normal 17

TABLE 6: MYELOGRAPHIC FINDINGS

No of Cases
Irregular Filling Defect 5
Serpentine Filling Defect 5
Total Block 3
Enlargement of Spinal Cord 2

TABLE 7: ANGIOGRAPHIC FINDINGS

	No of Cases
Single Coiled Vessel	1
Cluster of Vessels	1
Glomus Malformations	2
Incomplete Filling	9

TABLE 8: METHOD OF TREATMENT

Surgical Procedures	No of Cases
Biopsy	1
Nidus Coagulation	3
Resection of AVM	12
Embolization	2

TABLE 9: SURGICAL RESULTS

	Nidus Coagulation	Resection of AVM	Biopsy	Total
Improved	3	3	-	6
Unchanged	7	-	1	8
Worsened	2	-	-	2
Total	12	3	1	16

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RADIATION MYELOPATHY MIMICKING SPINAL TUMORS

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Radiation myelopathy is a rare but well documented condition, which is invariably met as an iatrogenic lesion following irradiation of malignant tissues adjacent to the spinal cord. This condition was first described by Ahlbom in 1941 (1). Since then, with a lot of reports and clinical features and pathological findings of this entity have been well described (3, 4, 12, 13). Two major categories are discerned (7, 11). The first is the Lhermitte sign, as a transient form of radiation injury with paresthesia running down the spine and limbs, usually triggered by neck flexion. It usually occurs about three months after radiation exposure and resolves spontaneously in several months (11). It may also occur as a first sign of chronic progressive radiation myelopathy. It is considered to be due to a temporary demyelination of sensory neurons (7). The second category comprises permanent forms of injury. The first form of this category is a lower motor neuron disease due to selective injury of the anterior horn cells (7, 11). The second form is an acutely developing paraplegia due to infarction of the spinal cord, believed to be a result of radiation induced vascular changes (7, 11). The third and most common form of permanent radiation change is chronic progressive radiation myelopathy. It usually starts with paresthesia and, in most instances, resulting in further sensorimotor disturbances, bowel and bladder dysfunction and paraplegia (7).

The incidence of this complication is difficult to determine because many patients die of their malignant disease before the cord lesion matures, but is estimated to be between 1 and 2 percent (4, 12).

Diagnosis of radiation myelopathy is usually made with a history of spinal cord irradiation, neurological findings, a normal myelogram, and a normal protein content of CSF. But for the first time Fogelholm et al. (6) reported a case of radiation myelopathy with a completely blocked spinal canal due to swollen, necrotic cord and a very high protein content of the CSF, mimicking an intramedullary neoplasm. They stressed that radiation myelopathy need not always be associated with a normal myelogram and CSF protein levels (6, 10).

Perusal of the literature has revealed additional cases of radiation myelopathy associated with definite swelling of the spinal cord at myelography, but without postmortem verification (2, 8, 10, 13).

In most patients, the disease began with symptoms in one or both lower extremities. Sensory symptoms predominated, especially burning paresthesia and inability to perceive pain and temperature are prominent. This suggests the involvement of the spino-thalamic tract (3).

The purpose of this report is to present two of the seven radiation myelopathy cases of our clinic in which the neurologic complications began with muscle weakness beginning in the lower extremities and a myelography with an enlargement of the spinal cord.

The original diagnosis of our patients were breast cancer and lymphoepithelioma of nasopharynx. They received a radiation doses of 4500 R and 5500 R respectively. After the radiation therapy, there was a symptom free interval of 6 and 7 years before the myelopathy became apparent. In both patients, the disease began with symptoms of weakness in one of the lower extremities, although it is reported that sensory symptoms are the prominent feature in this syndrome.

Roentgenograms of the spinal segments were obtained on both patients and the findings were normal except for minor degenerative arthritis. Radioisotope bone scannings were also in normal limits. The myelograms showed enlargement of the spinal cord in both patients and a high CSF protein level was found in the first patient.

A number of case reports remark a temporary improvement in the neurologic functions after the administration of steroids (3, 4, 6). Both of our patients were also improved on treatment with dexamethasone 16 mg. doses given over 3 weeks period with recovery of power in affected limbs. The rescreen myelograms one, two and three months later, showed change in the degree of cord enlargement. The patients were discharged with reduced doses of steroids but shortly afterwards they presented relapses.

The diagnosis of radiation myelopathy is made by excluding other causes of progressive myelopathies (9). The most common diagnostic error is the mistaken identification of radiation myelopathy, like an intramedullary metastatic lesion (9, 10, 11). In radiation myelopathy, symptoms tend to develop slowly, however in intramedullary metastasis rapid development of complete transverse myelopathy occurs. Intramedullary metastatic lesions are also significantly rare complications of cancer (11). Another condition of interest in the differential diagnosis of radiation damage to the spinal cord is the necrotizing carcinomatous myelopathy. It is one of the several syndromes which in recent years have come to be recognized as remote effects of cancer on the nervous system (11). In such instances, it is well to remember two important points: First, more than 75% of the patients with radiation myelopathy have had associated tumors of the head and neck, most of them being carcinomas of the larynx, pharynx, tonsils and tongue. Secondly, carcinomas of head and neck almost never metastasize to the spinal cord or have associated carcinomatous myelopathy.

Nowadays it is well known that permanent myelopathy developed in cases when the upper and lower neck and thorax were irradiated with multiple fields (5, 7). Kim and Fayos (7) stressed that the divergence of the beam from these multiple fields produced a significantly higher dose to the spinal cord.

However, in cases where multiple fields to the neck and breast are necessary, extreme caution should be taken to ensure that no theoretical or technical errors are made that will allow the delivery of a high dose at the field junction area and this produce a transverse myelitis, as we speculate that happened in our cases. Prognosis has been poor in the chronic forms of radiation myelopathy (11, 12). Survival after the onset of symptoms has varied from weeks to years, depending on intercurrent disease and the status of the primary malignant neoplasm. Death usually results from pneumonia or urinary tract infections as a direct result of the neurological deficit.

As a final conclusion, we would like to point out that radiation myelopathy need not always be associated with a normal myelogram and normal CSF protein levels and temporary improvement in neurological function after the treatment with steroids can be expected.

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SYRINGOMYELIA

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Syringomyelia is uncommon and there are some controversies on its pathogenetic mechanisms. Between 1965-1987, twenty patients with syringomyelia were treated at Hacettepe University Department of Neurosurgery. In syringomyelia males tend to be affected more frequently than females. Eleven of twenty patients were between 20 and 40 years of age. The common complaints in syringomyelia are asymmetrical diminution of sensation plus muscular weakness at and below the level of the cyst. The symptom complex which is typical for syringomyelia is bilateral diminution of temperature perception and asymmetrical hypoalgesia. The surgical procedures includes laminectomy with syringostomy for drainage. In only three patients polyethylene tubing to maintain communication between the cyst and the subarachnoid space was used. In the remaining two cases suboccipital craniectomies with cervical laminectomies were done.

Three were lost in the follow up period. The neurological status of these three patients was essentially unchanged from their preoperative condition. Ten patients were classed as having obtained excellent results from surgical treatment of syringomyelia. The condition of nine patients was considered to have remained unchanged. One patient continued to deteriorate after the operation.

The term 'syringomyelia' has been used to describe a cavitation of the spinal cord. Destructive central cord cavitation and gliosis are common in all forms. This condition is often gradually resulting in pain, amyotrophy dissociated anesthesia, paraparesis, scoliosis and eventually the development of trophic lesions.

Syringomyelia has been treated in the past by a variety of methods, such as myelotomy or irradiation.

Between 1966 and 1988, twenty patients with syringomyelia had been surgically intervened at Hacettepe University Department of Neurosurgery.

The purpose of this paper is to present these cases and to review the literature.

MATERIALS AND METHOD:

The files and neuroradiological examinations of patients had been reviewed and compared with the current publications.

RESULTS

Sex and age distribution are summarized in Table 1. Follow up period was ranging from 3 months to 22 years. The mean follow up period was 3 years. Two of twenty cases have had anomalies of craniovertebral junction. The most common complaint in syringomyelia is an asymmetrical diminution of sensation plus muscular weakness at and below the level of the cyst. Sixteen cases were males and four cases were females. Nine of the twenty patients were between 10 and 19 years of age. Seven patients did not have onset of symptoms prior to the age of 30 years.

Table 2 summarizes the symptoms upon admission of the twenty patients, weakness in both arms were the most common complaint, followed by pain and numbness of the arms. Sensory loss was noticed by nine patients.

The neurological examinations showed lower motor neuron signs and upper motor neuron signs in twelve cases. Ten cases were saved loss of pain and temperature sensation. Additionally, Homer's syndrome, abnormal posture of the head and cafe au lait spots were seen in one case. Three cases had painless burns for ten years. The radiological studies showed wide cervical canal in ten cases. Atlanto-occipital fusion and basilar invagination were seen in two cases. Eight cases had normal radiological appearance.

The value of cerebro spinal fluid protein level was elevated in eighteen of the twenty cases. Two patients had values of 200 mg/dl. The value of protein content in fluid removed from syringomyelic cavities ranged from 15 to 60 mg.

Myelography demonstrated widening of the cord in twenty cases, complete block at C6-7 in one case but the foramen magnum region appeared normal in eighteen cases. CT showed syringobulbia in one case. Delayed CT with Iohexol showed large spinal cord from C2 to the upper thoracic region in two cases. A central "bull's eye" within the spinal cord was found in one case.

SURGICAL PROCEDURES:

In this study, twenty six surgical procedures had been performed in the twenty patients. Five patients had required more than one procedure. Twenty four syring drainage procedures were performed. These included myelotomy in 20, placement of a syringosubarachnoid drain using silastic shunt tubing in three, lumboperitoneal shunt in one, terminal ventriculostomy in one case. Foramen magnum decompression alone and lysis of adhesions and membranes were performed in one patient. Foramen magnum decompression and plugging of the obex with muscle was performed in the other patient.

SURGICAL RESULTS:

Ten patients showed improvement signs and symptoms in the postoperative period. There were no change in nine patients and one patient showed deterioration. One patient did not come to control neurological examination. Improved results: in this group following periods ranged from 3 months to 22 years. Six patients had cervical laminectomy with simple drainage of the cyst and one patient had thoracic laminectomy with syringosubarachnoid shunt and two patients had foramen magnum decompression.

No change results: nine patients were classed no change results. In this group eight patients had cervical laminectomy with simple drainage of the cyst, one patient had cervical laminectomy with syringosubarachnoid shunt. One patient was deteriorated after the surgery. As preoperative neurological examination revealed paraparesis, postoperative examination showed paraplegia in the three years follow up period. Syringostomy was performed in this case

Pathologic examination demonstrated moderately loosing, infiltration of mononuclear cells and cleft in the normal neuronal structure and did not show any neoplastic cell in two patients. In this series we have had no postoperative death. One patient had CSF leakage in postoperative period and had been repaired.

DISCUSSION:

The pathogenesis of syringomyelia remains unknown. There are such mechanisms insults (1), transudations or exudations from intramedullary gliomas (2,3), focal edema (4), trauma and hydrodynamic theory of Gardner (6). In our cases, two of twenty cases had Arnold-Chiari malformations. One of them had hydrocephalus. The other eighteen cases were accepted as idiopathic syringomyelia. We did not include the syrinxes occurring inside the tumors in our cases.

When neurological examination does not allow precise localization, myelography was the first chosen method (7). Myelography was performed in nineteen of twenty cases and seventeen cases demonstrated widening of the vertebral canal. As stated in the recent neurosurgical literature, CT with contrast enhancement had demonstrated syringomyelic cavity (8). CT with Iohexol was performed in three of our cases. CT showed "bull's eye" in two cases. The other one did not show intramedullary cyst. It is indicated that this case is noncommunicating type syringomyelia.

Faulhauer and Loew (9) reported that syringostomy was performed and neurologic improvement was found in only two of ten patients, Love and Olafson (7) found improvement in ten of thirty five patients, Pitts and Graff (10) indicated improvement or no change in seventeen of twenty eight patients. In our series, nineteen of twenty patients showed neurologic improvement. Tator (11) reported improvement in fifteen of twenty patients.

Gardner's operation was performed in one patient. This patient was neurologically improved. The mortality rate of this procedure was reported 10% (12). In nineteen cases, we preferred syringostomy.

Syringostomy was a safe and successful procedure. The postoperative period was very comfortable for the patients.

TABLE 1: AGE AND SEX DISTRIBUTION

Sex	0-9	10-19	20-29	30-39	40-49	Total
Male	1	8	3	4	-	16
Female	-	-	1	3	-	4
	1	8	4	7	-	20

TABLE 2: SYMPTOMS

	No of Patients
Weakness in both upper extremities	10
Difficulty in walking	7
Numbness in the upper extremities	7
Numbness in the face	1
Pain	4
Incontinence	3
Scoliosis	1
Painless Burn	4
Abnormal posture of the head	1
Nocturia	1

TABLE 3: FINDINGS

	No of Patients
Lower motor neuron signs in the arms	14
Upper motor neuron signs in the legs	12
Impaired pain and temperature sensation	10
Abnormal posterior column sensation	6
Cranial nerve signs	4
Homer's syndrome	1
Abnormal posture of the head	1
Kyphoscoliosis	2
Nystagmus	2
Burns	3
Cafe' au lait	1

TABLE 4: MYELOGRAPHIC FINDINGS

	No of Patients
Widening of the cord	17
Complete block	2
Partial block	1

TABLE 5: LEVEL OF LESION

	No of Patients
Cervical	15
Cervicothoracic	1
Thoracic	2
Lumbar	1
Medulla Oblongata	1

TABLE 6: SURGICAL PROCEDURES (26 OPERATIONS IN 20 CASES)

	No of Patients
Gardner's operation	1
Suboccipital craniectomy	1
Syringostomy	20
Syringo subarachnoid shunt	3
Lumboperitoneal shunt	1
Terminal ventriculostomy	1

TABLE 7: SURGICAL RESULTS

	No of Patients
Improved	10
No changed	9
Deterioration	1

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CONGENITAL CRANIOVERTEBRAL JUNCTION ABNORMALITIES

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The craniovertebral junction (CT) terminology comprises the inferior part of occipital bone, foramen magnum and atlas and axis vertebrae. Bony structures of posterior cranial fossa and upper cervical canal are in close relationship with cerebellum, brain stem, spinal cord and their coverings.

Deformity of this region is first described in 1790 by Ackerman (10).

Skull base and occipital bone develops from four occipital sclerotomes. Atlas is formed by the fusion of caudal half of the last sclerotome and cranial and caudal halves of the first cervical sclerotome. The first cervical sclerotome also gives rise to the odontoid process.

There are two occipito-atlantal articulations and four atlanto-axial joints with a common synovial lining between dense and atlas. The second cervical nerve passes through the capsule of each atlanto-axial joint.

Lots of roentgenologic methods and measurements had been derived for the evaluation of the craniovertebral junction. Standard radiologic measurements include the basilar angle, Chamberlain's (2), Mc Gregor's (7) lines, the digastric line of Fischgold or Metzger, the mastoid line, the height index and antero-posterior dimension of foramen magnum.

Basilar angle is drawn from nasion through the tuberculum sellae to the anterior lip of foramen magnum. This angle should not exceed 140 degrees. Chamberlain's line extends from the posterior aspect of the hard palate to the posterior rim of foramen magnum. Mc Gregor's line joins the posterior end of the hard palate to the lowest point of occipital bone. Digastric line joins the digastric notches. Antero-posterior diameter of foramen magnum must not exceed 19 mm (2, 4, 10, 11, 13).

Basilar impression and platybasia are used as synonyms although they represent different processes. The term platybasia implies an abnormal basilar angle (more than 140 degrees) and should be restricted to the widening of base angle (4, 6, 11, 12). Basilar impression or invagination represents the upward displacement of the margins of the foramen magnum into the posterior fossa (fig. 1, 2).

The assimilation of C1 is a term used to indicate the fusion of the first cervical vertebrae to the foramen magnum.

Craniovertebral junction abnormalities may be congenital, acquired, inflammatory and/or traumatic.

MATERIAL AND METHOD:

32 patients suffering from congenital craniovertebral junction abnormalities were admitted and undergone to surgical intervention in Hacettepe University Medical School, Department of Neurosurgery. Age and sex distributions, symptoms at the admission, other systemic deformities, neurological and roentgenographic findings, ways of surgical interventions and postoperative results were reviewed and discussed with the literature.

RESULTS:

The ages are given in Table 1. The oldest patient was 62 and the youngest one was 5 years old. Ten patients gathered in the fourth decade by forming the highest incidence. 21 patient in our series were male and 11 were female.

Headache was the leading symptom at the admission to the hospital with an incidence of 50%. Pain in neck, vertigo and motor weakness in one side were the following symptoms. Table 3 shows the symptoms at the admission. Time interval between the beginning of the symptoms and the admission was averaged 2 years and are seen in Table 4.

Short neck was found in 11 patients and 5 patients had low hair line. Scoliosis and kyphoscoliosis were observed in 4 and 2 patient respectively.

In neurological examination, 26 patients had found to have motor changes. 12 of them were hemi, 6 were quadri, and 5 were monoparetic. Cerebello-vestibular signs were found in 20 patients and cranial nerve palsies were observed in 18 cases. Table 6 shows the neurological findings.

In plain X-rays, basilar impression was observed in 84% of cases followed by platybasia (65%). The assimilation of atlas was observed with an incidence of 61%. Myelography was performed to 22 cases and CT scanings had done to 8 patients.

All patients underwent to surgical intervention. Suboccipital craniectomies with C1, C1+C2, C1+C2+C3 laminectomies were performed in 8, 12 and 12 cases respectively. Posterior fusion with suboccipital craniectomies and laminectomies were performed in 7 cases. Table 9 shows the surgical techniques.

In long term follow up examinations, 78% of cases had excellent results and 9.40% remained unchanged. Mortality rate was found to be 12%. Surgical results were reported in Table 10.

DISCUSSION:

Craniovertebral junction abnormalities may be congenital, acquired, inflammatory or traumatic. In this study only congenital craniovertebral junction abnormalities are presented. Although all of the cases were congenital, the symptoms presented themselves in third and fourth decade. The bone maturation and beginning of brain stem ischemia aggravated by the skull base deformities are the causes of this findings. The male to female ratio is found to be 2:1. The male predominance is slightly higher in our series (11-12).

The clinical history of the patients having craniovertebral junction abnormalities were ranging from two weeks to 16 years. The cause of this varying period of time is the difficulties in differential diagnostic problems from other diseases like multiple sclerosis, cervical disc disease and vertebrasiler insufficiency, brain stem pathologies etc.

Craniovertebral junction abnormalities present themselves with myriad of symptom and signs including cerebello-vestibuler, cranial nerve and pyramidal dysfunctions. They are secondary to compression and ischemia of neural tissues (9, 11, 12). Motor changes were found in 26 cases (81%). This is the same as Lorenzo's series (79%) but it is different from Van Gilder and Menezes' series (9, 11, 12). Though cerebello-vestibuler sign were seen in 20 patients (62%). Lorenzo et al., found that 74% of their patients had nystagmus and other signs (5).

There was a cranial nerve palsy in 18 patient (58%). In Lorenzo et al.'s series cranial nerve palsy was seen in 46% of cases (5). Van Gilder and Menezes reported the 12 th cranial nerve palsies was found in all cases (9, 11, 12). In contrast, 12th cranial nerve palsy was seen in only 4 cases (12%).

In recent years CT of craniovertebral junction abnormalities has been employed to visualize abnormal bony relationships about foramen Magnum and neural tissue. We believe that, the most important roentgenologic studies for diagnosis are plain x-ray, vertebral angiography and CT. Basilar impression was the most frequent bone abnormality, which was seen in 84% of cases. Lorenzo et al. found that in 74% (5). Platybasia was the second frequent change. Herniation of the cerebellar tonsils has often been reported with basilar impression. There was Arnold Chiari Malformation in 16 cases (50%), Clippel-Feil Syndrome in 8 cases (25%) and Syringomyelia in two cases. Arnold Chiari Malformation and Basilar impression may also been together in the cases with congenital CJA (3, 4, 6, 13). In this study, they were seen together in 16 cases. A five years old girl with craniovertebral junction abnormalities also had pearly tumor reported by E-bengi previously (3).

Although less frequent, the association of craniovertebral junction abnormalities and syringomyelia is reported (1, 3, 4, 6, 12, 13). In our report, 2 of the patients with congenital craniovertebral junction abnormalities had syringomyelia. It is very difficult to determine whether the syrinx primary or secondary.

In the patients with asymptomatic craniovertebral junction abnormalities, surgical treatment is not necessary. When they became symptomatic, surgical intervention should be carried out in order to cure or improve the progressing signs. Surgical treatment is dependent upon the precise roentgenographic demonstration of the underlying pathology (3, 4, 6, 11, 12, 13). All of our patients had operated with posterior approach. Suboccipital craniectomies with C1, C2 or C3 laminectomies were performed.

We have 3 postoperative deaths because of sepsis and aspiration. The origin of sepsis is pneumonia due to aspiration caused by nine and tenth cranial nerve palsies.

We want to underline that lots of craniovertebral junction abnormalities were misdiagnosed and inappropriate treatment modalities were applied; in fact only a plain X-ray film can be sufficient to diagnose.

TABLE 1: AGE DISTRIBUTION

	Number of Cases
0-10	2
11-20	6
21-30	7
31-40	10
41-50	4
51-60	2
61+	1
Total	32

TABLE 2: SEX DISTRIBUTION

	Number of Cases
Female	11
Male	21
Total	32

TABLE 3: SYMPTOMS

	Number of Cases
Headache	16
Motor Weakness	16
Neck Pain	10
Vertigo	10
Gait Disturbance	9
Diplopia	6
Dysphagia	5
Dysarthria	5
Loss of Hearing	1

TABLE 4: DURATION OF SYMPTOMS

	Number of Cases
0-3 months	3
4-12 months	3
1-3 years	10
4-6 years	4
7-10 years	1
11-15 years	3
15+	2
Total	32

TABLE 5: PHYSICAL FINDINGS

	Number of Cases
Short Neck	11
Low Hairline	5
Scoliosis	4
Kyphoscoliosis	2

TABLE 6: NEUROLOGICAL FINDINGS

	Number of Cases
Motor Deficits	26
Cerebellar Dysfunction	20
Cranial Nerve Palsies	18
Sensory Loss	10
Reflex Pathologies	10
Spasticity	7
Increased ICP	3

TABLE 6a: MOTOR FINDINGS

	Number of Cases
Hemiparesis	13
Quadriparesis	7
Monoparesis	6

TABLE 6b: CRANIAL NERVE FINDINGS

	Number of Cases
Fifth Nerve	1
Sixth Nerve	4
Seventh Nerve	2
Ninth Nerve	12
Tenth Nerve	12
Eleventh Nerve	3
Twelfth Nerve	4

TABLE 7: DIAGNOSTIC PROCEDURES

	Number of Cases
Plain x-rays	32
Myelography	22
Angiography	19
Computerized Tomography	8
EBC	4
EMG	3
Radionuclide Scintigraphy	2

TABLE 8: CRANIOVERTEBRAL JUNCTION ANOMALIES

	Number of Cases
Basilar Impression	27
Platybasia	21
Assimilation of Atlas	20
Arnold Chiari Malformation	16
Clippel Feil Syndrome	8
Odontoid Process Anomalies	4
Atlanto-Axial Dislocation	2
Syringomyelia	2
Cervical Spina Bifida	1

TABLE 9: SURGICAL PROCEDURES

	Number of Cases
Suboccipital Craniectomy + C1 Laminectomy	8
Suboccipital Craniectomy + C1+C2 Laminectomy	12
Suboccipital Craniectomy + C1+C2+C3 Laminectomy	12
Suboccipital Craniectomy + Posterior Fusion	7
Duraplasty	9

TABLE 10: SURGICAL RESULTS

	Number of Cases
Excellent	16
Improved	9
Unchanged	3
Exitus	4

DIASTEMATOMYELIA

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Diastematomyelia was first described by Nicolai Tulp in 1624 on an autopsy material. Ollivier is credited with the origination of the term in 1837, deriving it from the Greek "diastema" meaning cleft, and "myelos" meaning marrow or medulla. In 1842, Cruveilhier described the septum (23).

Diastematomyelia (DSM), a primary embryological malformation and a form of spinal dysraphism, is characterized by a division of a variable length of the spinal cord or cauda equina resulting from a bony, fibrous or cartilaginous spur which transfixes the neural elements and dura. The spur may extend in a sagittal plane for a variable number of segments, rarely in two separate sites. A complete or partial sagittal division of the neural axis into halves is usually accompanied by a number of other malformations at the same or other levels of the spine. Diastematomyelic spur may occur at any point along the spine but is most common in the lower thoracic and lumbar area with a peak of incidence at L2 level.

DSM means cleft of the spinal cord or cauda equina, and it is to be differentiated from diplomyelia. The term "diplomyelia" means a true doubling of the spinal cord and implies two fully formed spinal cords each with a full complement of nerve roots. A true duplication has never been reported, and the pathological specimens examined so far merely represent different degrees of DSM (7).

The etiology of DSM is not known and several embryological theories have been proposed. Generally the theories involve a primary or an extrinsic disturbance that results in secondary splitting of the neural ectoderm (7, 13, 17).

Symptoms and signs related to DSM are due to traction or compression ischemia. Traction is mainly caused by the septum, the dural cleft, the adhesive bands outside and inside the spinal dura, or by an associated tight filum. The septum may also cause a compression ischemia as well as the axial distortion of the descending fiber bundles as they are deviated from the midline or an associated abnormality elsewhere in the spinal canal. Some of the associated abnormalities are obvious, while others are detected by neuroradiological investigations or at operation. The most frequently found vertebral anomalies associated with DSM are: congenital scoliosis, kyphosis or lordosis, local and/or remote multiple level spina bifida, vertical laminar fusion, split vertebral body, hemivertebral hypoplasia, fused or deformed spinous processes, fused vertebral bodies. Other abnormalities that may occur with DSM are cutaneous changes in the midline of the back, foot deformities, congenital dermal sinus, hydromyelia, tethering of the cord by a thick filum terminale, anterior spina bifida, myelomeningocele or meningocele, Arnold-Chiari malformation, spinal masses as epidermoid, teratoma, lipoma, neurenteric cyst, arachnoid cyst. The majority of patients have cutaneous manifestations which may not be at the same level with DSM. These are hypertrichosis, a small dimple, congenital dermal sinus, subcutaneous fatty tumor, pigmented nevi, hemangiomas, meningocele. It is suggested that all these anomalies in patients must have resulted from a single embryological alteration occurring early in fetal life.

CLINICAL MATERIAL:

The clinical material referred in this paper was gathered from the neurosurgical clinic of the Istanbul Medical Faculty between 1963 and 1988. There were 10 females and 4 males (female to male ratio: 2.5:1), with an age range of 1 to 28 years (mean 10 years). The presenting features, clinical findings, septum levels, diagnostic plain X-ray findings, associated pathologies are shown on tables 1 to 5.

TABLE 1: PRESENTING FEATURES IN 14 CASES OF DSM

Feature	No. of Cases	Percent of Cases
Meningocele	9	64
Local hypertrichosis	8	57
Foot deformity	8	57
Asymmetric limbs	7	50
Muscle weakness	6	42
Sensory impairment	6	42
Sphincter disturbance	5	35
Pain	4	28
Congenital scoliosis	4	28
Limp	2	14
Hemangiomas skin changes	2	14
Ulceration and trophic skin changes	2	14
Lordosis	2	14
Kyphosis	1	7
Dimple	1	7
Subcutan, fatty tumor	1	7
Fibrolipoma	1	7

TABLE 2: CLINICAL FINDINGS IN 14 CASES OF DSM

Findings	No. of Cases
Stretch reflex changes	9
Meningocele	9
Local hypertrichosis	8
Foot deformities	8
Asymmetric legs	7
Muscle weakness	6
Sensory changes	6
Sphincter disturbances	5
Pain	4
Congenital scoliosis	4
Lordosis	2
Limp	2
Hemangiomas skin changes	2
Ulceration and trophic skin changes	2
Congenital dermal sinus	1
Subcutan fatty tumor	1
Pigmented nevi	1
Fibrolipoma	1
Kyphosis	1
Congenital hip luxation	1

TABLE 3: LEVEL OF THE SEPTUM IN 14 CASES OF DSM

Level	No. of Cases
Th10	1
Th11	2
L1	2
L2	2
L3	5
L4	2

TABLE 4: DIAGNOSTIC PLAIN X-RAY FINDINGS IN 14 CASES OF DSM

X-ray Findings	No. of Cases
Spina bifida	14
Abnormal midline density	12
Widened interpedicular distance without erosion	12

Other vertebral anomalies found included, hemivertebral hypoplasia in 4 cases, congenital scoliosis in 4 cases, fused ("block") vertebrae in 3 cases, lordosis in 2 cases, kyphosis in 1 case, vertical laminar fusion in 1 case.

All patients underwent myelogram, the last six were CT-combined myelography with intrathecal Iohexol. In all patients, a filling defect was present. In 4 patients, the spinal cord was tethered in association with a thick filum terminale. CT-combined myelography revealed the dysraphic anomalies of the vertebral bodies, the fibrous, cartilaginous, or bony spur, the divided cord or cauda equina and the associated abnormalities. EMG was performed in 3 patients showing chronic neurogenic involvement in the related myotomes.

TABLE 5: ASSOCIATED PATHOLOGY IN 14 CASES OF DSM

Feature	No. of Cases
Tethered cord	4
Intradural lipoma	1
Congenital dermal sinus	1
Arachnoidal cyst	1

All patients were surgically treated. At operation, diastematomyelic spurs and dural clefts were removed completely, intradural exploration was performed, bands or adhesions were dissected, and other abnormalities were appropriately treated. The operation microscope was used when necessary. A two year-old patient died postoperatively as the result of an anesthetic complication, in another patient who was one and half years old, a postoperative respiratory distress occurred and needed thacheostomy. Neurological improvement were obtained in all 13 patients and results were evaluated as satisfactory.

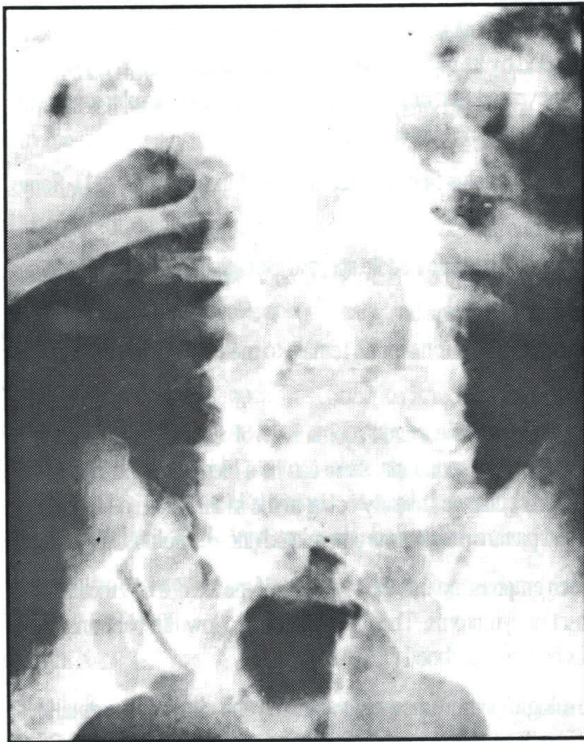


FIGURE 1: PLAIN X-RAY IN ONE OF THE CASES

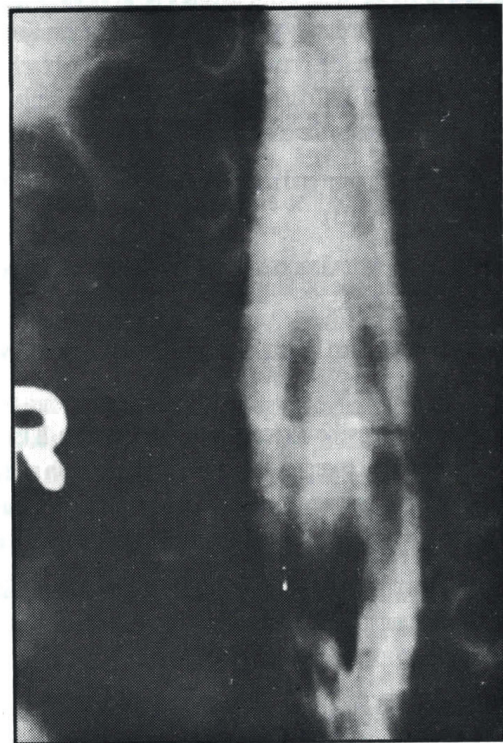


FIGURE 2: MYELOGRAM IN ONE OF THE CASES

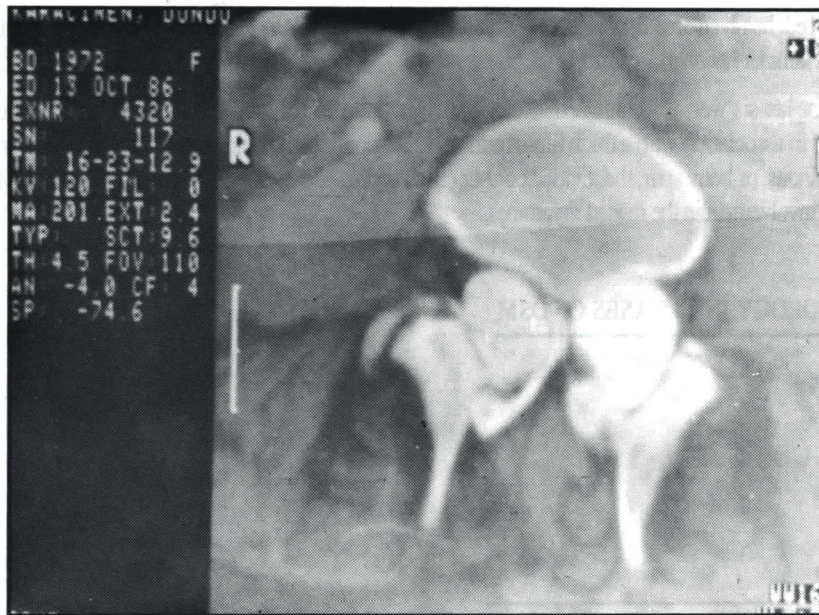


FIGURE 3: AXIAL COMPUTED TOMOGRAM WITH INTRATHECAL IOHEXOL IN ONE OF THE CASES

DISCUSSION:

In some patients of a different form, DSM may not be associated with a septum; in which case each hemicord has separate pial linings but a single arachnoid and dural tube surrounding both hemicords. But in the majority of patients a septum immediately caudal to the dural cleft and formed of bone, cartilage, or fibrous tissue is present between the hemicords, and each hemicord is surrounded by its own pial, arachnoidal and dural sheath. Thus free upward movement of the spinal cord during physical exercise, particularly spinal flexion, is prevented, and direct pressure, traction, and vascular injury can occur (10). In the majority of cases, the cord does reunite, but occasionally, when the lesion is at low level, it may stay separate.

A true family incidence is unknown and most authors deny a genetic influence. But in 1964, Kapsalakis first reported the DSM in two sisters (21). Some authors mention family history (23).

Most of the literature patients were diagnosed at the first decade, but the presentation ranged from birth to late middle age, the average being four years. In our material, the average was ten years.

DSM occurs in females more often in a ratio of three and one half to one of the reported cases (7). In our material, female to male ratio was two and one half to one.

The level of the DSM influences the clinical signs and symptoms. If the lesion is low in the lumbar spine, cauda equina is involved and the findings will be those of lower motor neuron compression, usually unilateral. In a lesion in the level of the conus medullaris, there can be a blend of upper and lower motor neuron lesion with bilateral weakness or paralysis, spasticity, pathologic reflexes. Sensory changes usually occur in the saddle area and especially patients with late onset of symptoms in adult life complaint from back or leg pain, the clinical picture may mimic a herniated nucleus pulposus.

The initial occurrence of symptoms in adult life that are attributable to DSM is rare. It has been emphasized that the low level of the lesions and the fact that the spinal cord or cauda equina did not reunite below the spur are factors delaying the onset of symptoms. These patients with a low lumbar transfixing septum or tethered cord can remain free of symptoms throughout life or develop symptoms only in adulthood (7, 20).

James and Lassman (20) and Futhkelch (10) have described the "orthopedic" and "neurologic" syndromes which classify the clinical abnormalities. Children with orthopedic syndrome may have scoliosis alone or in association with a stiff back and foot abnormalities. Some of the patients with DSM were asymptomatic and the incidence of DSM in the large series of patients with congenital scoliosis is about 5 percent and perhaps would be higher if all the patients had neuroradiological investigation. For this reason, any patient especially with a widened interpedicular diameter and/or in the presence of deficient posterior elements should have neuroradiological investigations prior to a surgery for scoliosis, irrespective of the presence or absence of a neurological deficit.

Patients who have neurological abnormalities show it more frequently unilaterally and they manifest it as muscle weakness or paralysis, atrophy of the thigh or calf, and an absent ankle jerk. Urinary incontinence and poor bowel control are less common than motor and sensory disturbances but patients who have no overt sphincter difficulties will show abnormality on preoperative urodynamic testing. Asymmetry of lower extremities is frequent and

suggestive. Foot deformities, ulceration and trophic skin changes, particularly about the foot and toes are common presenting complaints. Children with Sprengel's deformity (congenital elevation of the scapula) have an unusually high incidence of DSM (20 per cent), but other anomalies of the upper extremity are uncommon and the combination of these developmental defects suggest that it may be due to a common embryological maldevelopment (1).

Twenty percent of the literature cases were neurologically asymptomatic and were evaluated because of a cutaneous manifestation or an incidental radiological findings (7). In our material, five of the 14 patients had no neurologic deficit (35 per cent).

Of course, there is an inevitable overlap between the two categories and the clinical picture with orthopedic manifestations, neurologic findings and cutaneous changes should be considered as the common clinical entity.

Patients with suspect DSM should be assessed with neuroradiological investigation. Plain roentgenograms of the spine in DSM are characteristic and striking. An ossified septum is revealed in most of the cases and best seen on the anteroposterior view. Since the septum originates from mesoderm, the structure may vary from fibrous tissue or cartilage or fibrocartilage in 25 per cent to bone in 75 per cent of the patients (7). In our material, 12 cases had a bony, and one a fibrous septum. The interpedicular distance is increased and the pedicles, usually normal, can be hypoplastic in the widened area. Widening of the spinal canal with erosion and thinning of the pedicles should suggest an intraspinal expanding mass rather than a DSM. The diastematomyelic septum may undergo development and increased ossification with age. Spina bifida is generally present and at more than one level of the spine as a so-called "skip" lesion. Associated vertebral abnormalities with DSM is extremely varied and a higher incidence of vertebral abnormalities occurs in patients with scoliosis.

Plain tomography doesn't greatly increase the accuracy of diagnosis and it exposes the patient to unnecessary radiation.

With the use of myelography, the septum or spur can be graphically demonstrated as a central filling defect in the canal at its widest portion (29). And other abnormalities may be revealed.

Patients with suspect DSM are best assessed with CT-combined myelography. It demonstrates the abnormalities, particularly the site, extent, and asymmetry of the spinal cord. CT examination shows the dysraphic anomalies of the vertebral bodies and, when present, the axial development of the fibrous, cartilaginous or bony spur as it penetrates the divided cord or cauda equina, as well as its dorsal attachment (17).

CT-combined myelography demonstrates the presence and shape of septum, hemicords, arachnoid and dural tubes which encompass the hemicords, the septum formed by the medial walls of the two dural tubes, the cleft situated between the two walls of the dural septum, the bone spur within the dural cleft, and the presence of any tethering dorsal fibrous bands or aberrant dorsal nerve root (30).

The preliminary experiences with MR imaging of DSM suggests that once the bony details of the abnormality are defined, it can delineate the presence and extent of the divided spinal cord as well as its associated abnormalities adequately obviating other studies (14).

Evaluation of the fetal neural axis is an integral part of the obstetric sonographic examination. Congenital neural defects identified in-utero include hydrocephalus, encephalocele, anencephaly, and spinal dysraphism. In 1984, Richard A. Williams and Richard A. Barth first reported identification of DSM with sonography (39).

The treatment of DSM is surgical; its correction is recommended as a prophylactic measure against further neurological damage. But the timing of surgery is controversial. If there are no signs and symptoms, it would seem prudent to withhold surgery until they develop. The patient should be closely followed with periodic clinical and electrophysical examinations (EGM, evoked potentials). When signs or symptoms are present, surgery is indicated. The purpose of the operation is to remove the septum, its dural sleeve, and adhesions to the neural tissue completely, giving the spinal cord or cauda equina free mobility within the thecal sac, and to treat any other abnormalities. Surgical correction of DSM and other pathology is necessary before treatment of scoliosis.

To prevent the irreversible and progressive neurological damage of DSM, early diagnosis with a complete neuroradiological investigation and surgical correction is necessary.

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DIASTEMATOMYELIA WITH CONGENITAL SCOLIOSIS

Report of 20 surgically treated cases

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Diastematomyelia is a primary embryological malformation involving division of a variable length of the spinal cord in to two hemicords of more or less equal caliber (2, 4, 7, 8, 9, 11). The anomaly occurs in both occult spinal dysraphism and spina bifida apperta (3). Cutaneous changes are encountered in cases of diastematomyelia (Table 1). Sometimes initial complaint is scoliosis (Table 2).

When it coexists with scoliosis, the problem in management of the scoliosis in the combined lesion is much more complex than it is for scoliosis without diastematomyelia and the diastematomyelia is often occult (1, 3, 5, 10).

In this paper we present twenty cases of diastematomyelia which were treated surgically.

PATHOLOGY:

Diastematomyelia occurs with or without a septum. The cord is normal above the level of the diastematomyelia and usually reunites below the level of the split and again becomes normal.

Because no true duplication of the cord occurs, each division represents an equal or unequal portion of the spinal cord. Central canal bifurcates to extent into each hemicord and reunites below the split. Anterior spinal artery also bifurcates at the splites so that each hemicord retains an anterior spinal artery.

The spinal cord was divided at a single level in 96% of the patients reported in the literature. 4% of the cases was divided more than one septum (6). In our cases it is 100%. We demonstrated the septum as a filling defect with myelographic evaluation (Table 3).

Partial diastematomyelia is an incomplete dorsal division of the spinal cord that leaves the anterior bridge intact.

A septum of some form was found between the hemicords of 90% of the patients described in the literature.

The septum is located in the cervical spine in 1%, in the thoracic spine in 28%, in lumbar spine in 70% and in the sacrum in 1%. Since septum originates from mesoderm, the structure may vary from fibrous tissue or cartilage or fibrocartilage in 25% to bone in 75% of patients.

Each hemicord surrounded by its own dural tube near the level of the septum.

Abnormalities of the posterior elements are the most common skeletal defects and multilevel spinal bifida, fusion of adjacent hemilaminae or spinous processes are frequent.

Abnormalities of fusion such as hemivertebrae, butterfly vertebra may occur. This combination of posterior and anterior skeletal abnormalities causes widening of the interpedicular diameter. Congenital scoliosis is frequently associated with the vertebral body abnormalities (13 cases).

OPERATION:

Is has been performed in our series with the patient in prone position under general anesthesia. One or two segments above and below the site of the bony defect must be exposed.

It is important to be very careful, as in all operations, in approaching the spinal canal to avoid inadvertent damage to neural structures through an area of deficient bone.

The paraspinous muscles on each side were freed and retracted laterally as in any standard laminectomy. The laminectomy was then extended above and below the lesion until the dural cleft has been completely exposed. The dura surrounding the bony spur or septum was then gently separated from the spur by blunt dissection. The spur was then removed piecemeal until the base of the spur has been made flush with the anterior wall of the spinal canal. Bleeding from the spicule base was controlled with bone wax. Following removal of the spicule, the dura was opened. The dural opening begun in the midline usually below the site of bifurcation and carried around the edge of each dural channel adjacent to the spicule. Arachnoidal adhesions were also divided until the cord is freely movable. No attempt was made to close the dura anteriorly. The dura was closed posteriorly in a linear manner. Routine wound closure in layers without drainage was carried out.

RESULTS:

There has been no significant surgical complication and mortality. Postoperative radiological evaluations have confirmed the removal of the bony spicule. Postoperative follow up was 6-48 months. There is no reoperation due to neurological deterioration.

CONCLUSION

Diastematomyelia associated with the presence of a bony spicule which transfixing the spinal cord or cauda equina has been encountered in 20 operative cases.

It seems apparent that progressive neurologic impairment of lower extremities and the rectal and vesical sphincters may result from increasing distortion of neural axis as a result of fixation produced by these bony spicules during the growth of vertebral column.

The diagnosis is suspected in the presence of cutaneous midline defects, muscular imbalance in the lower extremities, gait disturbance, scoliosis, deformities of the feet or fecal incontinence or increasing enuresis.

Operative treatment is laminectomy with extradural removal of the spicule as possible followed by dural reconstruction.

TABLE 1: CUTANEOUS CHANGES

	Cases
Hypertrichosis	8
Meningocele	4
Dimples	2
Capillary Hemangioma	2
Nevus	2

TABLE 2: INITIAL COMPLAINTS

	Cases
Scoliosis	13
Foot Deformities	8
Hairy Patch	8
Gait Changes	6
Sphincter Control	1

TABLE 3: MYELOGRAPHIC FINDINGS

Filling Defect Level	Cases
Th8-Th9	2
Th11	3
Th12-L1	2
L1-L2	4
L2-L3	6
L4	1
L5	2

TABLE 4: SITE OF THE SEPTUM

Single Septum	100%
Cervical	0%
Thoracic	25%
Thoracolumbar	10%
Lumbar	65%
Sacral	0%

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MENINGOCELE AND MYELOMENINGOCELE

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Most of the neurosurgical problems in infancy and childhood are due to congenital malformations, neoplasms, infections and trauma. Meningocele and myelomeningocele are important malformations, which can be corrected surgically.

Spinal dysraphism is an umbrella term used to designate all the forms, open and closed, of spina bifida. The dysraphism may be occult with or without cutaneous hallmarks or open with rudimentary neuroectodermal tissue which is visible somewhere along the spinal axis.

Meningocele, the simplest form of neural tube defect is characterized by a cystic lesion which consists of meninges only and contains cerebro spinal fluid (CSF). The neural tissue may or may not be visible at the base of the lesion during the operation. The far more common form of open tube defect is myelomeningocele. This term is usually used synonymously with spina bifida aperta, spina bifida cystica and open neural tube defect. Open neural tube defect occur in 1.0 to 1.5 per 1000 live births in North America (5, 7). The defect is four times more common in Britain, it is much less common in Japanese population and very rare in Manila (7).

MATERIAL AND METHOD:

This retrospective review includes 191 cases whose spinal dysraphism were treated surgically at the Hospital of Hacettepe University, Department of Neurosurgery during the last ten years (1977-1987). We excluded the cases who never underwent operation in one or another reason.

RESULTS

The ages of the patients on admission ranged from two hours to 12 years (Table 1). 53 of them (28%) were admitted to the hospital in the first week of their lives. 66% were under 90 days of age. 109 of the cases were male (57%) and 82 were female (43%). The male to female ratio was 1.32 (Table 2).

Malformations were located on lumbar and lumbosacral region in 79% of cases, in cervical region in 8%, in thoracic region in 9% (Table 3). All of the cases admitted to hospital because of a mass located somewhere along the spinal axis, except two. These two cases did not have apparent mass, but had the complaints of incontinence. Their ages were 9 and 12. 27 cases had CSF leakage. 18 of them were located in lumbar area (Table 4). There were different degree of the motor deficits in 46 cases (24%). 8 of them were totally paraplegic (Table 5).

All of our patients were treated surgically. Surgery directed to removal of the sac, division of the dural attachments to neural tissue and repairing the skin defect. A shunting procedure was carried out in the same operation if the patient had progressive hydrocephalus due to associated congenital anomalies or had a large mass in myelomeningocele cases. Meningocele and myelomeningocele were performed in 131 (71%) and 53 cases (28%), respectively. Laminectomy with small meningocele had to be performed in two cases who did not have apparent mass (Table 6).

Hydrocephalus was observed in 32 cases, 18 of them (56%) developed within first 15 days postoperatively (Table 7). 15 cases treated surgically and shunting procedure was performed at the same operation. In some cases with Arnold Chiari malformation, aqueduct stenosis e.t.c., hydrocephalus was observed preoperatively and in some cases hydrocephalus was expected. 60% of cases showed normal progress, all of them had meningocele. Neurologic deficits unchanged in 99% of cases who had myelomeningocele (Table 8). Hydrocephalus was the most common complication followed by sepsis and wound infection (Table 9). The most common causes of death were sepsis, pneumonia, central nervous system infections such as meningitis and/or ventriculitis.

The incidence of associated congenital anomalies is higher than the general population (4-7, 10). Common anomalies were pes equinovarus, scoliosis, hemivertebra, diastematomyelia, aqueduct stenosis, Arnold Chiari malformation, e.t.c.

DISCUSSION:

We believe that the main aims of operative treatment are preservation of neural function, the prevention of infection and removal of the disfiguring mass in the patient with spinal dysraphism. We also prefer surgical intervention for the patients who have partial neurological deficits since improvement is expected.

Early surgery carries special risks particularly with regard to hypotemia and hypovolemia. Surgery should be carried out as early as it is medically feasible (1, 4, 6, 8, 11). Urgent repair is performed if the lesion has ruptured, but grossly uninfected and child's general condition warrants. A shunting procedure is carried out at the same intervention in order to prevent CSF leakage if the size of the sac is quite large and there is a progressive hydrocephalus due to associated anomalies such as Arnold Chiari malformation, aqueduct stenosis, e.t.c. Supportive therapy may be advisable if operative repair of spinal dysraphism is delayed because of some causes.

TABLE 1: AGE DISTRIBUTION

	Number of Cases	%
0-1 days	11	6
1-7 days	43	22
8-30 days	31	16
1-3 months	42	22
4-6 months	18	10
7-12 months	27	14
1-7 years	11	6
7+ years	8	4
Total	191	100

TABLE 2: SEX DISTRIBUTION

	Number of Cases	%
Male	109	57
Female	82	43
Total	191	100

TABLE 3: LOCALIZATION

	Number of cases	%
Cervical	16	8
Thoracal	18	9
Lumbar	124	65
Lumbosacral	25	14
Sacral	8	4
Total	191	100

TABLE 4: DISTRIBUTION OF CSF LEAKAGE

	Number of Cases	%
Cervical	1	3
Thoracal	5	18
Lumbar	18	67
Lumbosacral	3	12
Total	27	100

TABLE 5: MOTOR FINDINGS

	Number of Cases
Paraparesia	32
Monoparesia	6
Paraplegia	8
Total	46

TABLE 6: SURGICAL PROCEDURES

	Number of Cases	%
Meningocelelectomy	135	72
Myelomeningocelelectomy	38	19
Myelomeningocelelectomy+V-A Shunt Insertion	13	6.5
Myelomeningocelelectomy+V-P Shunt Insertion	2	1
Laminectomy+Meningocelelectomy	2	1
Myelochysis Repair	1	0.5
Total	191	100.0

TABLE 7: DURATION OF HYDROCEPHALUS

	Number of Cases	%
0-15 days	18	56
16-45 days	10	31
46-75 days	3	10
76+ days	1	3
Total	32	100

TABLE 8: SURGICAL RESULTS

	Number of Cases	%
Improvement	113	60
Unchanged	42	22
Exitus	36	18
Total	191	100

TABLE 9: COMPLICATIONS

	Number of Cases	%
Hydrocephalus	32	16
Sepsis	15	7
Wound Infection	15	7
Ventriculitis+Meningitis	10	5
CSF Leakage	6	3
Pneumonia	4	2
Shunt Infection	2	1

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ATLANTO-AXIAL ROTATORY FIXATION

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CASE REPORT

Twelve years old girl, first admitted to Dokuz Eylül Medical School, Department of Neurosurgery on March 1987 with neck pain complaint that was started 20 days before her admission. Trauma or upper respiratory tract infection story hasn't obtained. On examination the occiput was slightly tilted to the left, causing the face to be rotated to the right and tilted upward (Fig.1). Neck and head movements were restricted in all directions. Other physical and neurological examinations were normal. Routine blood and urine analysis were normal, other than ASO 1250 IU/ml. X-ray films of the cervical spine were shown typical findings of atlanto-axial rotatory subluxation. CT scans confirmed the diagnosis (Fig.2). Cervical traction was applied for 10 days and antibiotherapy was instituted. Partial regression on pain was seen, but the subluxation was still going on, when the patient discharged in April 1987 with cervical collar.

In June 1987 she was rehospitalized, because of progression of her complaints. Conventional tomography revealed the subluxation of the left atlanto-axial joint. Cervical myelography was normal. Retraction was again applied, but control X-ray films and complaints were unchanged. So that, we decided to the operation.

Operation: Under general anesthesia, patient was placed on prone position, suboccipital midline incision was made, C1-C2 were identified, 20 no. gauge wire was passed under posterior arch of atlas and tied, than C2 spinous process was drilled and wire passed through the drill hole and two vertebrae tied, open reduction was tried with the aid of twisting fastened wire. After the decortication of laminae, iliac otogenous cips bone grafts were implanted. After operation Minerva cast was applied for 8 weeks. The postoperative period was uneventful and she was discharged on July 1987. She was last seen on May 1988, the head position returned to normal, her pain relieved and X-ray films showed compact fusion between C1 and C2 (Fig.3).

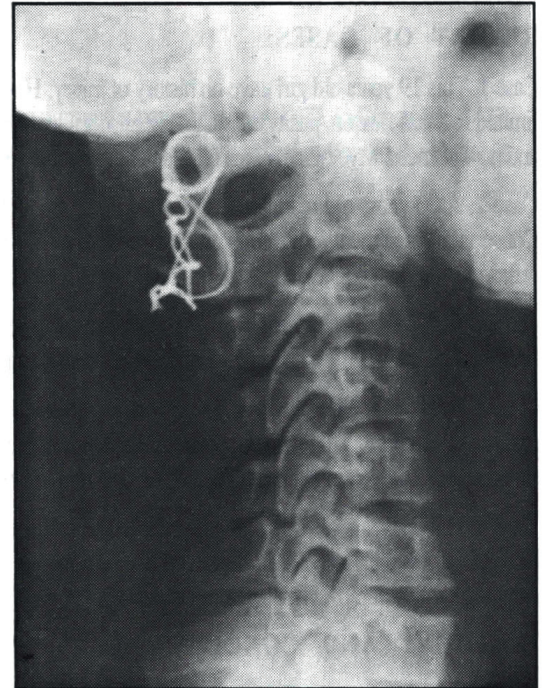
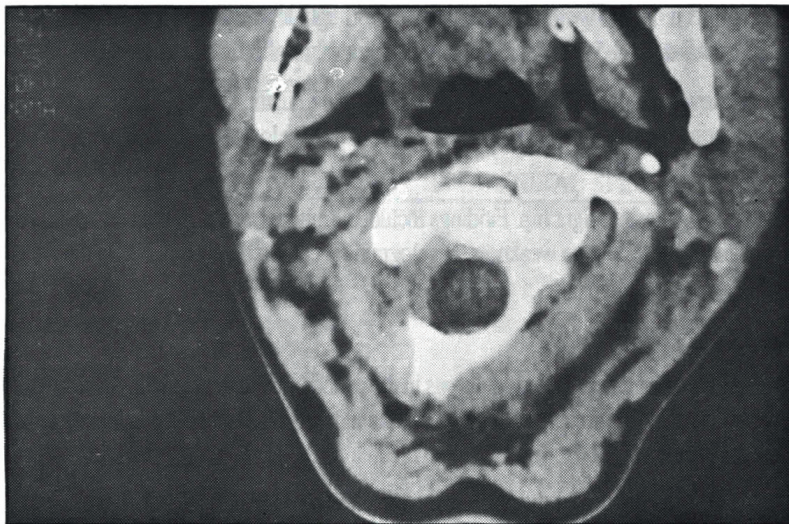
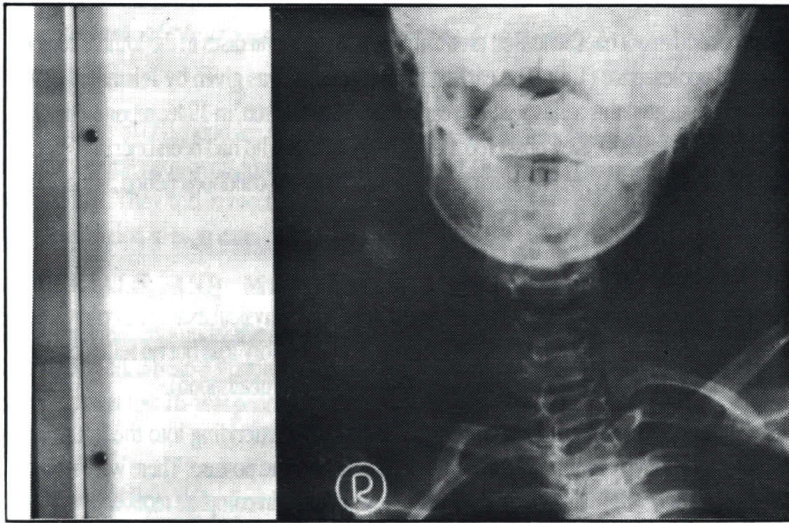
DISCUSSION

Rotational fixation of the atlanto-axial joint can be defined as a pathological fixation of the joint in a position of rotation. This means the articular masses of the atlanto-axial joints do not change their relationship with rotation of the head. The diagnosis is usually made by conventional radiography or tomography. The basic findings are those of persistent asymmetry of the odontoid in its relationship to the lateral masses of the atlas, not correctable by rotation (7). Cine-roentgenography is recommended to confirming diagnosis, but it is difficult to use in the presence of pain and spasm (4). CT can very readily demonstrate the pathological fixation of the rotational deformity of the atlanto-axial complex (6). In our patient the diagnosis was made on conventional radiography. Tomography and CT confirmed this diagnosis.

A perusal of the literature reveals that the usual etiologic factors involved are traumatic events. The onset, however may be spontaneous or it may be associated with an upper respiratory tract infection (6). The laxity of the ligaments may be the cause in these instances. Wortzman and Dewar concluded that the rotational fixation is "not due to a fracture or ligamentous rupture but to damage of an unknown nature at the atlanto-axial joint itself. The most plausible theory is a tear and invaginations of capsular ligaments about the atlanto-axial synovial joints" (7). Fielding and Hawkins believed that the reduction of the rotational deformity is "obstructed in the early stages by swollen capsular and synovial tissues and by associated muscle spasm. If the abnormal position persists because of failure to achieve reduction, ligament and capsular contractures develop and cause fixation" (3). In our case there was no history of trauma, confirmed by seeing no occult fracture on CT. Upper respiratory tracts infection story was also not obtained, but high ASO levels were present.

Rotatory fixation without anterior displacement of the atlas (type I) has been reported in only a few cases in which there has been a prolonged interval between beginning and diagnosis. Because of the delay, symptoms may persist for weeks or months (3, 4, 6). Wortzman and Dewar reported disappearance of symptoms after 1 to 3 weeks, either without treatment or following a period of immobilisation and traction (7). The radiological abnormality, however, persisted in all, but one of their 23 patients. In these patients because of persistence of severe symptoms a C1-C2 posterior fusion was finally done to alleviate the pain. The X-ray films, however still showed persistence of the rotational deformity. Fielding and Hawkins suggested skeletal traction first. If reduction is obtained, they advised immobilisation such as by continued traction or a Minerva Jacket, for 3 months (3). In their experience recurrence is common, so patients with long-standing fixation (more than 3 months) should be treated by arthrodesis of the atlantoaxial joint. Recently Johnson and Fergusson reported two cases of type I traumatic atlanto-axial rotatory fixation recognised and treated in the acute phase (4). Short period of halter traction (one week) was sufficient to improve the symptoms and radiological findings. In our case we recognised the entity in acute phase, but neither by 10 days traction, nor spontaneously the rotatory fixation of the atlanto-axial joint resolved. The cases previously reported in the literature have presented late and have been associated with chronic neck pain, torticollis and instability as in our case on second admission. Surgical reduction and fusion are advised. Bohlman et al stated that (1) "in chronic rotatory subluxation of the atlas on the axis reduction is not possible and manipulation should not be performed under anesthesia. Posterior arthrodesis results in adaptation of the head and neck to a straighter configuration once the arthrodesis is solid", as was in our case.

In view of the potential problems associated with chronic fixed rotation, it would seem important to recognise this condition, specially with the aid of CT scanning, and try to treat with traction in acute phase. In the failure or in chronic phase with persistence of symptoms, surgical posterior arthrodesis (wire, bone grafts) is necessary to resolve this problem.



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PROTRUDED LUMBAR INTERVERTEBRAL DISCS IN CHILDHOOD AND ADOLESCENCE

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In most of the texts about pediatric neurosurgical diseases, nothing is mentioned about backache. But, protrusion of intervertebral discs in the lumbar region, a type of back disorder is common rather than rare during childhood and adolescence (1, 9). The earliest report of series was given by Jelsma in 1944, reported a series of 150 cases of protruded intervertebral disc; the youngest patient in this series was 17 years of age (1). Wahren, in 1946, reported that he had removed a protruded intervertebral disc from a girl, 12 years of age (1, 4). In 1950, Key observed that only 4 patients who had been operated on for protruded intervertebral discs were in the period of childhood (less than 16 years of age) (1, 5). We have accepted the end of the childhood period as the 20th birthday.

REPORT OF CASES:

Case 1. This 19 years old girl gave no history of injury. However she developed low back pain with numbness in left leg. Physical examination revealed limited forward flexion, positive straight leg raising sign on the left and negative on the right. This patient had unilateral sensory loss but no reflex change and no weakness. Myelogram revealed a large L5-6 defect and surgical removal resulted in complete recovery (She had had lumbalisation).

Case 2. A 20 years old man developed pain in the buttocks following an episode of strenuous movement, with pain extending into the left thigh. Conservative treatment resulted in complete relief of his symptoms. This was followed by limited forward flexion and scoliotic posture. There were neither reflex nor sensory changes, and weakness. Myelogram revealed a filling defect at L5-S1 level and removal of the disc resulted in complete recovery.

Case 3. This 14 years old girl fell during playing basketball Findings included limited forward flexion, positive straight leg raising signs bilaterally but without sensory or reflex changes and no weakness. Myelogram revealed a defect at L4-5 on the left and surgical removal resulted in complete recovery.

Case 4. A 14 years old boy was injured by heavy lifting. He developed low back pain and had a positive straight leg raising sign and some slight toe extensor weakness. There was hypesthesia of L4 dermatome and moderate diminution of ankle reflex on the left. Myelogram was positive for disc protrusion at L4-5. Removal of this offending disc resulted in complete recovery.

Case 5. This 17 years old boy played football and developed pain in the low back and right hip. Findings included limited forward flexion and positive straight leg raising signs bilaterally. There were neither reflex, nor sensory changes, and no weakness. Myelogram revealed a defect of L4-5 on the right side, and surgical removal resulted in complete recovery.

COMMENT AND CONCLUSION:

A child or adolescent patient is not a small model of an adult and the diagnosis of herniated nucleus pulposus in the period of childhood requires alertness to this possibility (1, 3, 7). The incidence of protruded lumbar intervertebral discs (only 5 in our series of 1608 patients, that is 0.31 per cent) in our series is noteworthy inasmuch as the incidence is stated to be between 0.09 and 2.1 per cent (1, 7).

The clinical and pathological findings in five patients were similar to that of adults except that the signs were often more striking than the symptoms. Known trauma is precipitating factor in four patient. These findings are also similar with literature (1-3, 5, 6, 8).

In a review of the literature, vertebral level of the protrusions reported in the literature conforms with the most frequent sites of protrusion in adult patients (1-9). Out of 5 cases, 3 were at the levels of L4-5, one was L5-6 and one was L5-S1. Surgical outcome is very gratifying.

In summary, we should emphasize that protruded intervertebral discs in the lumbar region occur rarely during childhood and infrequently adolescence; the occurrence of low backache and sciatic pain in a child should arouse suspicion of the possible presence of a protruded lumbar intervertebral disc.

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EXTRADURAL SPINAL TUMORS IN INFANCY AND CHILDHOOD

A Review of 33 Cases

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Spinal tumors in childhood are not so infrequent as generally believed (1, 3). Secondary extradural spinal tumors are very rare but they represent the majority of all extradural neoplasms in infancy and childhood (1, 3, 4-6). These tumors compress the spinal cord and produce pain, motor weakness and sensory disturbances. They will in most cases lead to death in a relatively short period. Obviously the nature of the treatment will vary with the type of tumor and with the situation in each case.

MATERIALS AND METHOD:

Thirty-three patients under the age of 16 years who had secondary extradural spinal tumors treated during the period January, 1972, to December, 1987, were reviewed. These 33 patients represented 76% of all extradural tumors, and 44% in our series of 98 patients with spinal tumors in the pediatric age-group over this 16-year period.

RESULTS:

The age ranged from thirty-five days to fifteen years and there were 21 boys and 12 girls.

Histological diagnosis was available in all patients. Histologically, our cases include 11 non-Hodgkin's lymphomas, 6 neuroblastomas, 3 ganglioneuroblastomas, 3 Ewing's sarcomas, 3 malignant mixed tumors, 2 Hodgkin's disease, 2 malignant hemangioendotheliomas, 1 rhabdomyosarcoma, 1 lymphangiosarcoma and 1 osteogenic sarcoma.

TABLE 1: LOCATION OF SECONDARY EXTRADURAL SPINAL TUMORS

Location	Cases	
	No.	%
Cervical	6	18
Cervicothoracic	1	3
Thoracic	18	55
Thoracolumbar	2	6
Lumbar	3	18
Lumbosacral	3	18

Pain (28 out of total 33 patients; 85%) was the most common symptom followed by motor weakness (76%), pathological reflexes (70%), and then sensory changes (55%). Sphincter disturbance, spine tenderness, SLRT and gait disturbance were often seen. The presence of scoliosis and muscle atrophy were rarely encountered. There was no significant difference in symptoms or physical findings in patients with different type tumors.

TABLE 2: NEURORADIOLOGICAL FINDINGS IN PATIENTS WITH SECONDARY EXTRADURAL TUMORS

	Cases		Pathological Positive	
	No	%	No	%
X-Ray	33	100	18	55
Myelography	24	73	24	100
Spinal CT	6	18	6	100

All but three patients were treated surgically. The one patient who was not operated on had received radiotherapy and chemotherapy. Twenty-eight patients received radiotherapy and/or chemotherapy postoperatively. Out of 28 patients, 14 of the patients had only chemotherapy following surgical treatment.

DISCUSSION

A delay in diagnosis may lead to increased disability before treatment. We agree with Matson and Austin that disability resulted from the delay in diagnosis, rather than from progression of the disease postoperatively (1, 4, 7). The distribution of the tumors along the spinal axis was significantly different in our material, in appropriate with some other series (2, 4, 5, 7). The types of tumor encountered in our series do not differ from previous reports (1-4, 6, 7). The nature of the treatment will vary with the type of tumor and with the situation in each case.

In summary, the proper treatment of secondary extradural spinal tumors with compression of the spinal cord is laminectomy and removal of an adequate amount of tissue for decompressing the spinal cord. The laminectomy should be followed by radiation therapy and/or chemotherapy, depending upon the type of tumor. We should stress the importance of early diagnosis and surgical treatment in order to avoid irreversible neurological deficit.

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MALIGNANT SCHWANNOMA OF THE SPINAL CORD

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Schwannomas are benign tumors of the peripheral nerves (1). Mostly they are seen together with neurofibromatosis. Malignant schwannomas are very rare and usually developed from deep nerves (2, 3, 4). Malignant schwannomas of the spinal nerve roots are extremely rare (3, 4).

In this paper, a case of spinal nerve root malignant schwannoma is presented because of its rarity.

Case Report:

A 14 years old male patient, complaining of weakness and numbness on his lower extremities, was admitted to our clinic. The initial symptoms have been noticed four weeks ago and progressively developed during this period. His physical examination findings were normal. The neurological examination revealed paraparesis and hypalgesia below T5 level with diminished position sense. Slight ataxia was noticed while walking.

Routine spinal graphies were normal. In the myelographic examination which was done by lumbar route, complete block at T5 level and multiple round-shaped filling defects, 1 cm in diameter, were seen on the left S1 and, right L5 and S1 roots. There was also another round-shaped filling defect at the T9-11 level. The CT scan demonstrated an extramedullary intradural tumor compressing the cord at the T5 level. CSF was xanthochromic and its protein content was also quite high (600 mg%).

The patient was operated on, under general anesthesia, in prone position. Following T3-T6 midline skin incision, T4 and T5 laminectomy was performed; no extradural pathology was found. Intradural exploration revealed a tumoral tissue, developing from the T5 nerve root and embedded in the spinal cord. The thickened arachnoid was partially adhered to the spinal cord and to the tumoral tissue.

Histopathological examinations showed a tumor with a loose matrix, containing cells with oval, vesicular atypical nuclei. Among the tumoral cells, several bundles of peripheral nerve fibers were detected.

DISCUSSION:

Tumors developing from the nerve sheath can be seen in both sexes and in any age group (1, 4, 5, 6). 40% of the cases also have the diagnosis of neurofibromatosis. Cases located at the vertebral area with expansion into the spinal canal are very rare in the published series (4, 6, 7).

These tumors usually tend to spread along the nerves, and surrounding tissue invasion and seeding metastases are also seen (5, 7). In our case, multiple intradural metastases all along the spinal canal were determined.

The prognosis is worse in patients with neurofibromatosis, and the recurrence incidence is higher in this group of patients (4, 5, 6). Although the recurrence rate is around 50%, the best therapeutic approach is surgical intervention (2, 3). Systemic metastases are usually late and rare (1, 2, 4). In our case, there was no systemic metastase other than the spinal metastases. In general, chemotherapy and radiotherapy are not effective in such cases.

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TREATMENT OF EXTRADURAL SPINAL METASTASES

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Spinal metastases from malignant tumours with compression of the spinal cord or cauda equina are common clinical, neurosurgical, social and economic problems.

Spread mechanism of extradural spinal metastases are:

1. Lymphogen
2. Haematogen
3. Tumor cells groups can make metastases by body fluids or by body cavities.

However it is difficult to ascertain how often malignant tumors give rise to metastatic growth of malignant tumors.

Carcinoma metastases represent the largest group. Bronchial carcinoma is the most common primary tumor, followed by breast cancer in female, prostate cancer in male and hypernephroma metastases. The most extradural metastases are located in thoracic region followed lumbar than cervical and sacral spine.

MATERIAL

From 1973 to 1988, 26 patients with spinal tumor have been treated at the neurosurgery department of the state hospital İzmir, Turkey. We did not find 3 patient's files. 11 of 23 patients had extradural spinal metastases. 12 had spinal cord compression depending on other diseases, like benign tumors or infection.

General information of 11 patients has been shown at table 1.

TABLE 1

Sex	Age	Complaints	Localisation				Neurostatus	Plain x-ray	Myelogr.	Comp.Tomogr.	Surgery	Primary Tumor	Histopathology
			Cervical	Thoracic	Lumbar	Sacral							
1	F	42			L ₄ -L ₅		Paraparesis	Not available	L ₄ -L ₅ stop	-	Decompressive Laminectomy	Unknown	Unknown
2	F	70		Th ₈			Paraparesis	Normal	Th ₉ -Th ₁₀ stop	-	Dec. Laminec.	Unknown	Insufficient material, Unknown
3	M	37			L ₂ -L ₃		Paraparesis	L ₃ compression Th ₁₂ ped. dest.	L ₃ Subtotal stop	Spinal Tm.	Dec. Laminec.	(pathologist) Urinary bladder Kidney	Epidermoid Tm. metastases
4	M	54		Th ₃			Paraparesis	Th ₃ lysis, Th ₁₋₂ pedicle destruction	Th ₉₋₁₀ stop	-	"	(pat.) Lung or kidney	Malignant epithelial Tm.
5	M	42		Th ₄₋₅			Paraparesis	Th ₃₋₄ pedicle dest.	Th ₅₋₆ stop	Th ₁₂ -L ₁ Extradural Tm.	"	Kidney	Carcinoma metastases
6	M	62		Th ₁₂			Paraparesis	Normal	Th ₁₂ -L ₁ feeling defect	-	"	Unknown	Non-Hodgkin malign lymphoma
7	M	49		Th ₇₋₉			Paraplegia	Cervical arthrosis	L ₁₋₂ feeling def.	Metastatik Tm.	"	Unknown	Rabdomyo - sarcom
8	F	21		Th ₂			Paraplegia	Th ₂₋₄ pedicle dest.	Th ₁₂ total block	L ₄ met. Tm.	"	Unknown	Metastatic bone Tm.
9	F	60			L ₄		Paraparesis	L ₄₋₅ spondylo- lysthesis	-	-	"	Knee	Fibrosarcom
10	M	35			S ₁₋₂₋₃		Normal	Normal	Th ₃₋₄₋₅ epidural met.	-	"	Solitary bone myeloma	Malign myeloma
11	M	48		Th ₃₋₄			Paraparesis	Th ₄ comp. pedicle dest.	Th ₃ stop	-	"	Unknown	Epithelial Tm. metastases

CLINICAL SIGNS, TREATMENT AND GENERAL INFORMATION:

One of the first complaints of the patients is pain, under the level of spinal metastases. Patients have weakness and numbness on the lower extremities and there is a difficulty on control of micturition and defecation.

In practice symptoms are very silent at the beginning and mostly the physician does not attend to think or suspect a spinal cord metastases. For this reason previous complaints and signs are very important for diagnosis of extradural spinal cord metastases. According Meijer in 48% of the cases, primary tumor was not determined from the anamneses.

If physician thinks about the spinal cord metastases, diagnose is not difficult. For the diagnose: neurological examination, plain X-ray, CSF examination, Queckenstedt test, myelography and computerised tomography must be done.

When there is a patient with malignant disease in the anamnesis and complaints about back-ache, physician must think possibility of spinal cord metastases.

Treatment of spinal cord metastases.

1. Surgery: Decompressive Laminectomy
2. Radiotherapy
3. Chemotherapy
4. Cytostatics
5. Hormone therapy
6. Combined therapy

Decompressive Laminectomy:

- A) Anterior Laminectomy,
- B) Posterior Laminectomy,
- C) Postero-lateral Laminectomy.

Combined therapy: Aim of this treatment is to avoid better results which is not always possible.

TABLE 2: LITERATURE REVIEW: RESULTS OF DECOMPRESSIVE LAMINECTOMY

Authors	Year	Total Number of patients	Dec. laminect.	Preoperative		Not Paretic	Postoperative			
				Paraplegia	Paraparesia		Imp.	Min	Not Imp.	Unchanced
Chandler et al.	1954	39	39				2		26	
Alexander	1956	22		12		10	10		12	
Barron	1959	21					4		17	
Arseni	1959	350	249				29,8%		57,2%	5%
Kennedy	1962	103	59	9	38		21			
Smith	1965	52	52				13	8 min improve	7 det.	24
Hardy and Dugger	1967	39	39					50% minimal improve ment		
Çuhadar et al.	1988	11	11	2	9		Follow up unknown			

TABLE 3: LITERATURE REVIEW OF COMBINED THERAPY: DECOMPRESSIVE LAMINECTOMY + RADIOTHERAPY + CHEMOTHERAPY

	Total	Preoperative		Postoperative		Treatment
		Paraplegia	No Imp.	Improved	Ambulant	Dec. Laminectomy+Radio
Parese 1958						
Malignant	10	10			6	10
Myeloma						
Others	13					
Gilbert, Kim, Posner Mones et		235				170 only radia.
Dosier 1966	41					65 Dec. Lami+Radiotherapy
Malignant						Chemotherapy 46
Lymphoma		12			8	
Mammary carcinoma	9				2	
Lung Carcinoma	5		None			

They pointed out that in the literature authors put malignant lymphoma together with the other malignant tumor metastases in their study. They state that it is not correct to assess malignant lymphoma with the carcinoma. Because malignant lymphoma have better prognosis than carcinoma metastases.

Gilbert et al. prefer radiotherapy as a treatment for patients with spinal cord compression. They also advise corticosteroids.

Marshall and Langfitt studied 29 patients with malignant extradural spinal metastases. They started 40 mg./day dexamethasone. 17 patients were treated by decompressive laminectomy. 12 patients with radiotherapy+chemotherapy.

Neurological Status	Medical therapy		Surgical Therapy		Total	
	Sustained Success	Failure	Success	Failure	Success	Failure
I. Able to walk with assistance	5	1	0	1	5	1
II. Able to stand with assistance	4	6	3	3	7	3
III. Leg movement	3	10	2	8	5	8
Total	12	17	5	12	17	12

According to Marshall and Langfitt patients with Hodgkin, prostate carcinoma metastases with spinal cord compression has to be treated with dexamethason, radiotherapy of 2500-4500 Rads, chemotherapy or hormone therapy. For bronchial carcinoma, first choice should be decompressive laminectomy, because conservative treatment helps for a short time. In the cases of complete paraplegia, dexamethasone or decompressive laminectomy have no effect. They advise 40 mg. dexamethason per day.

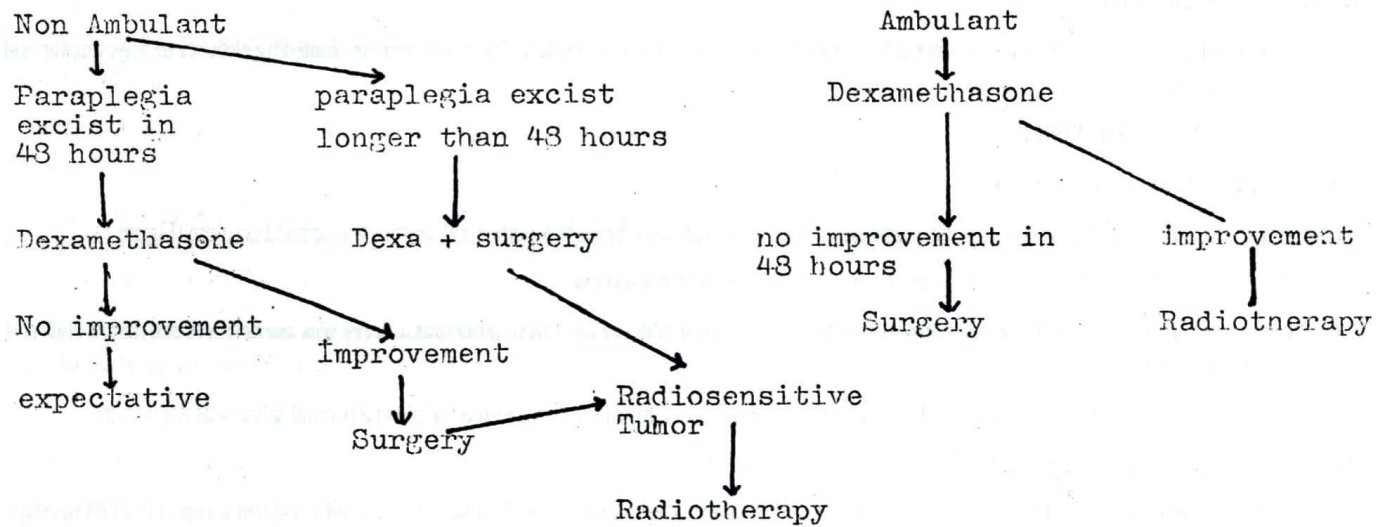
Surgery is indicated if:

1. Patient is younger than 70 years old
2. There is only one location in spinal canal
3. When survival is more than several months
4. General condition of the patient is rather good

Surgery is not indicated if:

1. Patient is not younger than 70 years old.
2. There are multiple metastases
3. When there is a short survival
4. When general condition of the patient is poor

TABLE 4:



CONCLUSION

Generally prognosis of paraplegic patients with extradural metastases that caused spinal cord compression are bad. How quick paraplegia exists, the worse prognose is.

Authors in the literature advice to make decompressive laminectomy as soon as possible, minimum 6 hours, maximum 72 hours. After this period laminectomy does not help anymore. Type of tumor plays a great role. Lung carcinoma, mammary carcinoma, testis carcinoma, stomach, intestine carcinoma, hypernephroma have poor prognosis than Hodgkin disease and prostat carcinoma.

Localisation of tumor metastases plays also a role because lumbar and cervical localisation have better prognosis than thoracic metastases.

We made a diagram for treatment of extradural spinal metastase as shown in Table 4.

SUTURELESS PERIPHERAL NERVE REPAIR WITH PLASMA ADHERENT EFFECT

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The well known suture techniques for anastomosis of the severed nerves for apposition and thereby facilitating growth of the regenerating neurofibriles is not always an entirely satisfactory procedure (1, 2, 3).

To exploit the different techniques, several adhesive methods of anastomosis for small nerves were studied in the laboratory animals. In 1940 Young and Medawar employed clotted plasma instead of silk to keep nerve ends in correct alignment (4, 5, 6, 7, 8). But this method has been forgotten for a long time and not used in clinical practice.

In this study the adhesive effect of plasma on transected peripheral nerves of rats was investigated. The results were evaluated by electroneuromyographic and histopathological methods.

MATERIAL AND METHOD:

In our study rats were divided into five groups.

Experiment group 1 (n:10) after transection of the sciatic nerve, the nerve ends were brought together and plasma was applied on them (Figure 1).

Sham control group 1 (n:10) instead of plasma normal saline was applied after transection.

Experiment group 2 (n:10) after producing segmental defect on sciatic nerve, a graft obtained from other sciatic nerve was inserted between the cut ends and plasma applied on (Figure 2).

Sham control group 2 (n: 10) After inserting a graft which was obtained from other sciatic nerve instead of plasma normal saline was applied on.

Sham control group 3 (n: 10) The cut ends of nerves were left without graft.

In the experiment adult male Norvegicus-Albino rats (400-450 gr) were used and all animals anaesthetised with sodium-thiopental (30 mgr/kg) intraperitoneally. In the experiment group 1 (n:10) sciatic nerves were explored before the division of tibial and peroneal components and the nerves were dissected free from surrounding tissue for 1 cm above the divisional junction. A sharp razor was used for transection of the nerve. 15 minutes later the cut ends were brought together and plasma applied on. After one hour of inspection and checking the stabilisation with minimal traction, skin was closed by silk sutures. In the control group I same procedure was performed but instead of plasma normal continuous saline irrigation was used to prevent the plasma collection. In the experimental group 2, 3-4 mm. segment from the left sciatic nerve was inserted between the defect and plasma applied on. Remaining procedures were done in usual manner. In the control group 2 same procedure was performed but instead of plasma, normal saline was used.

In the control group 3 (n:10) the grafts obtained from right sciatic nerves were left for spontaneous regeneration. In all experimental groups after reunion of proximal and distal ends light traction were applied on the nerves and adherent effect of plasma were checked before closure.

Six weeks later electroneuromyography and histopathological stainings were performed in all groups. The lesioned sciatic nerves were stimulated superiorly and inferiorly by needle electrode. The muscle response was recorded from m. gastrocnemius by concentric needle electrodes. Before taking a graft, right sciatic nerves were used for evaluation of normal ENMG values for detecting the normal distal motor latency values. After all ENMG were performed, sciatic nerves were removed and fixed in 10% normal solution. From paraffine block longitudinal serial section slices were obtained and stained with Hematoxylen-Eosin and myelin stains.

RESULTS:

ENMG was found excitable in all rats in the experimental groups except one rat (5%) in the first experiment group (Figure 3-4). In the control group I ENMG was found excitable on 5 rats (50%) and denervation potential at the gastrocnemius muscle on remaining 5 rats. In the second control group ENMG was found inexcitable for 7 rats (70%). In the third control group all sciatic nerves were found to be inexcitable and muscle response was not recorded even with high degree stimulus (Table 1).

After removal, the nerves were stained by H.E and myelin stains for light microscopic examination (Figure 5). The results were given in Table II.

DISCUSSION:

Several different techniques of peripheral nerve reunion have been reported (1, 2, 9, 10). The most commonly practiced method is extraneural suturing (1, 9). Most failures or bad results with conventional techniques are encountered by development of a scar tissue and tension effect in the area of nerve

anastomosis. Interfascicular graft anastomosis were employed to reduce the tension effect (1, 9, 10, 11). After the first homologous nerve grafting in 1870 many experimental and clinical studies were performed on nerve grafting. Different techniques and graft materials were tried. Recently muscle basal lamina was employed as a new graft material for repairing of nerves (12, 13, 14). In the conventional methods it is difficult to ascertain accurate approximation of nerve stumps with epineural suture. For this reason, to avoid usage of unnatural suture materials, some surgeons used adhesive substances to bring the nerve stumps together (1, 4, 6, 7, 15). Some investigators tried a tube or sheath of collagen, however all these materials caused in varying degrees of constriction or slippage and in long periods increased the formation of connective tissue (15, 16).

In 1940 Young and Medawar first attempted to reunite of severed peripheral nerve ends with plasma. Many investigators used this technique in experimental and clinical practice before microsurgical techniques and suitable suture materials were developed. Then adhesive and wrapping methods were abandoned (1, 9, 10). Since 1960 no other study has been performed on the plasma adherent effect. In our present study we investigated the long forgotten adherent effect of the plasma on severed nerve ends.

When we compared the results of ENMG values in experimental groups we did not find any significant difference. ENMG values of all animals were found to be excitable but one. Since there were normally large variations of amplitude and motor latency the detailed regeneration values could not be calculated. In contrast to the experimental groups, the sham control groups' (1-2) anastomosis results were found to be unsuccessful and ENMG were inexcitable (60%) ($p < 0.001$).

Combination of suturing and plasma adherent effects give better results in animals (3, 17, 18, 19). However in our study the results showed that plasma alone can produce sufficient anastomosis.

Inflammatory reaction and fibrosis were usually found when plasma and sutures employed together (1, 2, 3, 10, 21, 22). Our histological results showed fibrosis in all groups but there were more reactional tissue in the first group than the second (with graft). It was concluded that tension has a significant effect on the production of fibrosis. Some authors applied cortisone to reduce the reaction (23).

In conclusion plasma has adherent effect on the transected small nerves. Although it needs further investigations before it is used in humans. In the large nerves, due to the tension factors, the use of plasma is not advised (4, 18, 19).

TABLE I: THE RESULTS OF ENMG

EG 1 No.	DML*	EG 2 No.	DML	CG 1 No.	DML	CG 2 No.	DML	CG 3 No.	DML
1.	IE**	1.	1.7 msn	1.	IE	1.	IE	1.	IE
2.	1.4 msn	2.	1.5 msn	2.	IE	2.	IE	2.	IE
3.	1.6 msn	3.	1.4 msn	3.	1.4 msn	3.	IE	3.	IE
4.	1.8 msn	4.	1.8 msn	4.	1.8 msn	4.	IE	4.	IE
5.	1.7 msn	5.	1.3 msn	5.	1.4 msn	5.	1.3 msn	5.	IE
6.	1.9 msn	6.	1.6 msn	6.	IE	6.	1.7 msn	6.	IE
7.	1.6 msn	7.	1.7 msn	7.	1.7 msn	7.	IE	7.	IE
8.	1.6 msn	8.	1.8 msn	8.	IE	8.	IE	8.	IE
9.	1.4 msn	9.	1.3 msn	9.	1.3 msn	9.	IE	9.	IE
10.	1.4 msn	10.	1.4 msn	10.	IE	10.	1.6 msn	10.	IE

*IE : Inexcitable

**DML : Distal motor latency

TABLE II: THE RESULTS OF NEUROPATHOLOGY

EGI	EG 2	CG I	CG 2	
1. AV	1. N	1. AV	1. AV	
2. PN, IA		2. PN	2. AV	2. AV
3. PN, IA		3. IA	3., PN	3. AV
4. TB	4. IA	4. PN	4. AV	
5. PN, IA		5. MNCI, TB, IR	5. N	5. PN
6. PN, IA		6. N	6. AV	6. OOFI
7. TB	7. N	7. PN	7. AV	
8. IA, IR	8. PN	8. AV	8. AV	
9. IA, IR	9. PN	9. OOFI	9. AV	
10. IA	10. IA	10. AV	10. PN	

PN : Partial neuroma

IA : Incomplet anastomosis

N : Normal

TB : Total block

OOFI : Only one fascicule intact

MNCI : Mono nuclear cell infiltration

AV : Anastomosis unsuccessfull

IR : Inflammatory reaction

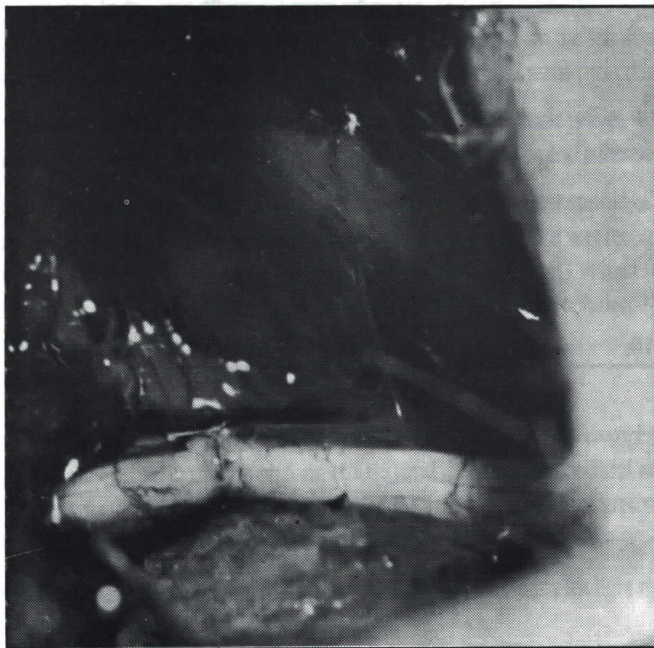


FIG 1: END-TO END ANOSTOMOSIS WITH PLASMA ADHERENT EFFECT.



FIG. 2: PLASMA ADHERENT EFFECT USING GRAFT

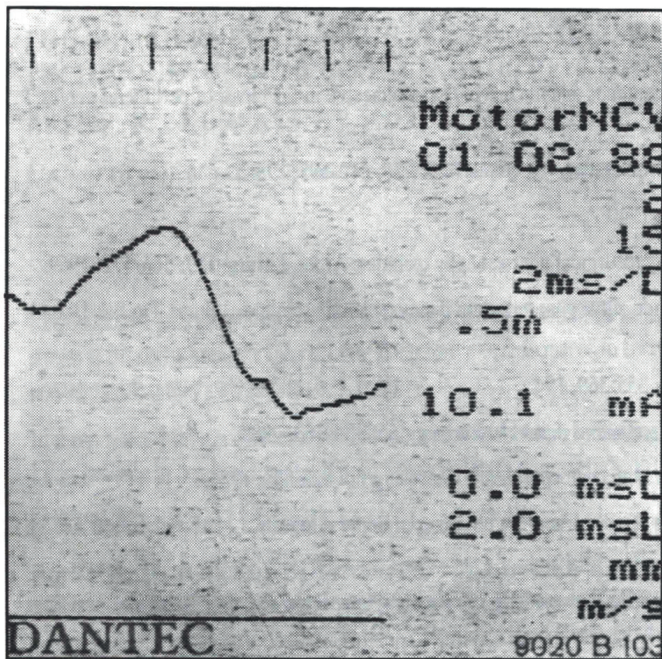


FIG. 3: ENMG IS SHOWING THE EXCITABILITY OF SCIATIC NERVE.

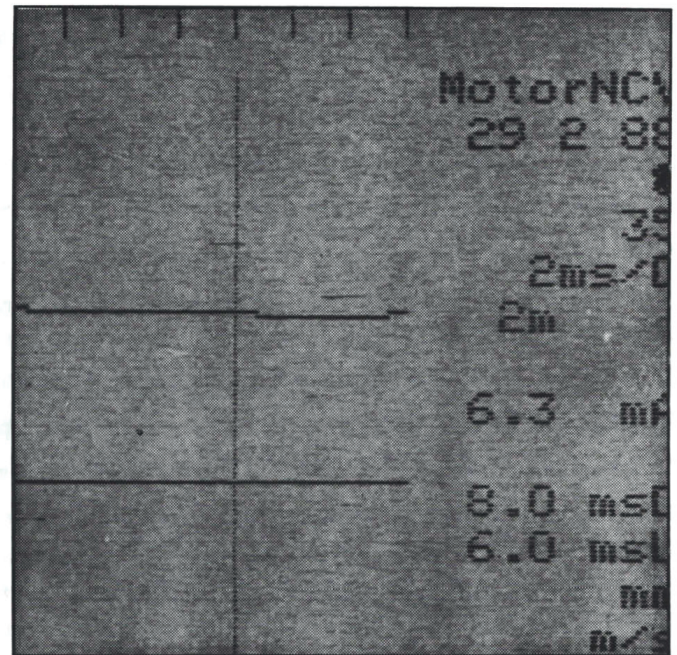


FIG. 4: THE FIGURE SHOWS AN EXAMPLE FOR INEXCITABILITY.

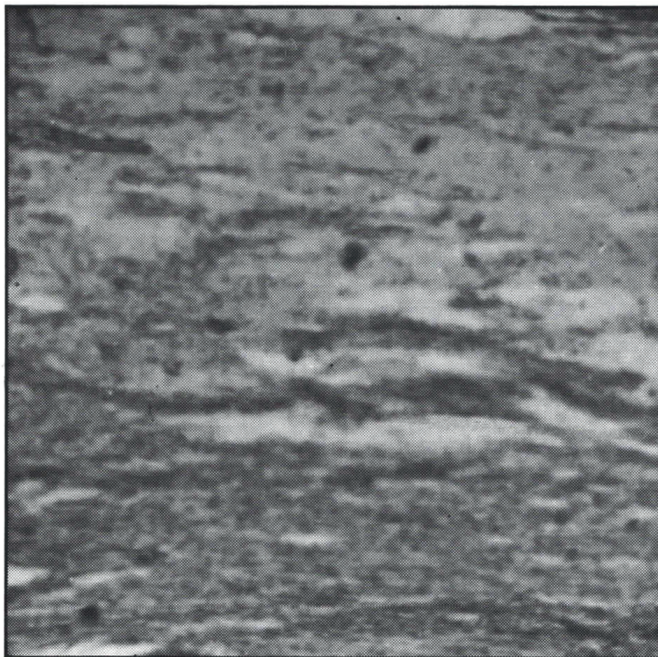


FIG. 5: HISTOPATHOLOGICAL MICROPHOTOGRAPHY SHOWS OCCURENCE OF PARTIAL NEUROMA (H&E)

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FOCAL CEREBRAL ISCHAEMIA FOLLOWING MIDDLE CEREBRAL ARTERY OCCLUSION. TECHNIQUE AND NEUROPATHOLOGICAL CONSEQUENCES

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Retrospective analyses of large groups demonstrate that incidence of infarction is 75% in stroked patients (1, 2, 3). On account of its frequency, ischemic stroke is the most important condition. Therefore it is reasonable to focus attention on the analysis of stroke models which can be produced in experimental animals with artery occlusions (4, 5, 6, 7).

In the present study, we investigated focal cerebral ischemia following middle cerebral artery occlusion by subtemporal craniectomy for the detection of infarcted area in cerebral tissue. (2, 3, 5) Triphenyl tetrazolium chloride (TTC) was used as a staining method.

METHOD AND MATERIAL:

Adult Norvegicus-Albino rats (200-250 gm) were anaesthetised with sodium thiopental (30 mgr/kg) intraperitoneally. Tracheostomy was performed and the animal was ventilated and normoxia and normocapnia were achieved by controlled ventilation. Polyethylene catheters were introduced into femoral artery and vein to allow repeated sampling of arterial blood gases and the administration of fluids when needed. The animals were maintained normothermic (37-38 C) during procedure. For this purpose rectal thermistor probe was inserted. After the animal was placed in supine position, a curved vertical 2 cm skin incision was made in the mid-point between the left orbit and the external auditory canal. The skin incision was retracted and parotid gland exposed. The vascular supply to the parotid was diathermied.

An incision was made around the superior and posterior margins of the temporalis muscle and the muscle was scraped and reflected forwards. Coronoid process of mandible and the zygoma were left in place. Inferotemporal fossa was then exposed. The floor of this fossa was formed by the pterygoid muscles across which passed the mandibular nerve. The muscles were retracted downwards and the mandibular nerve was followed medially across the anterior aspect of the temporo mandibular joint to the foramen ovale. A craniectomy (2-3 mm²) was made by microdrill 3 mm anterior and 1 mm lateral to the foramen ovale. (Figure 1) The dura was opened by a fine needle. White band of myelinated fibres which formed the lateral edge of the olfactory tract was seen and above this line middle cerebral artery was divided by a fine needle after cutting the arachnoid membrane and coagulating by bipolar forceps (Figure 2).

In the experimental group ten rats were used for MCA occlusion. In the sham control group (n:5) same procedure was made but MCA was not occluded. After 4 hours interval, all the middle cerebral artery occluded animals and sham group animals were decapitated. After carefully removing the specimens from the skulls, the brains were immersion-fixed in 25 ml phosphate buffer + 25 mg TTC for a minimum 30 minutes at 37-40 C (8).

RESULTS:

There were no areas of ischemia in the cerebral hemispheres of any of the sham operated animals by contrast in all the middle cerebral artery occluded animals. There was pallor of the cortex of the lateral convexity ipsilateral to the occlusion (100%). This was greatest in the frontal (100% n:10) and sensorimotor regions of the cortex (70% n:7) and variable in the other territory of MCA. This change was apparent both on the surface of the brain and in the coronal sections which showed pallor in the basal ganglia particularly in the lateral segment of the caudate nucleus (100% n:10). (Figure 3-4). In the medial segment of caudate nucleus, infarction was seen in 40 percent (n: 4) and for detection of infarction area specimens were also stained with Hematoxylen-Eosin (Figure 5).

DISCUSSION:

The laboratory analysis of the phenomenon leading to a brain infarction requires an animal model in which a) A single artery can be reproducibly occluded, b) The vascular occlusion results in predictable changes in blood flow (focal or regional ischemia), c) Barbiturates are not used at the time of arterial occlusion, d) Inducement of the above conditions should always result in a parenchymal lesion closely resembling a human brain infarction and e) The method of arterial occlusion should be compatible with subsequent reperfusion of the ischemic territory (5, 6).

For this purpose, in the literature many investigators produced ischemic model by different techniques. Ligation of the cervical arteries and temporal carotid artery, occlusion of an intracranial artery by transorbital approach, embolization with homologous blood are some of them (4, 6, 7, 9, 10, 11, 12, 13, 14). And in these, investigators used different animals. Experience with larger animals suggests that unless the middle cerebral artery is occluded near its origin a very variable lesion results (6, 7, 12, 13). Occlusion of an extracranial artery has disadvantage because most rodents have extensive intracranial collateral circulations. Embolization and ligation of an extracranial artery has a high mortality rate and the extent of brain damage is inconstant (4, 5, 6, 7, 9, 12). The occlusion of an intracranial artery usually proximal to middle cerebral artery is widely used to produce focal ischemia in larger animals such as cat, dog and

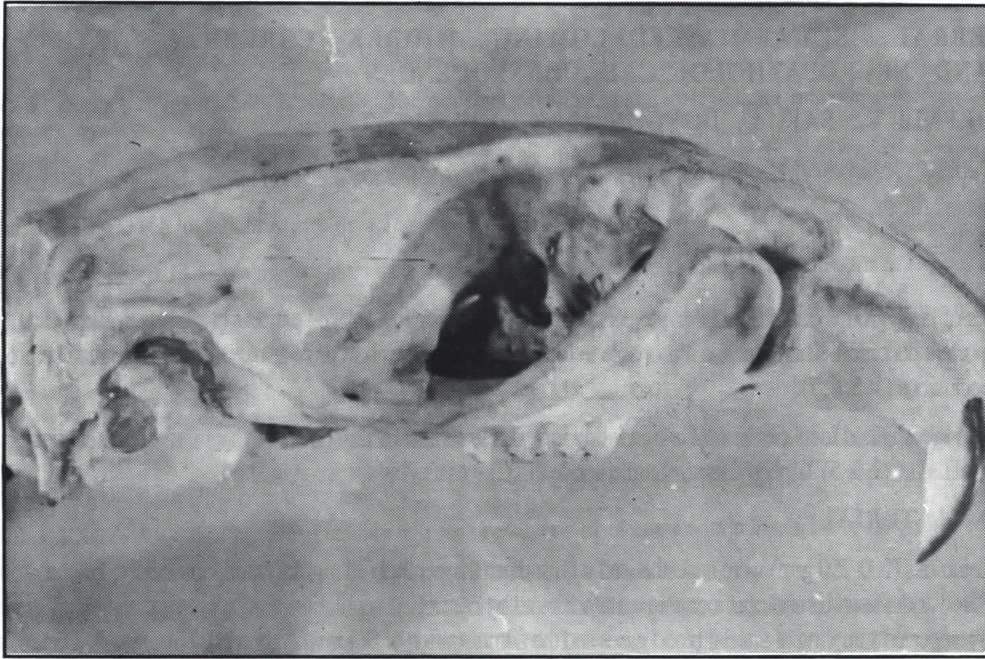


FIGURE 1: THE DEMONSTRATION OF FORAMEN OVALE AND CRANIECTOMY AREA

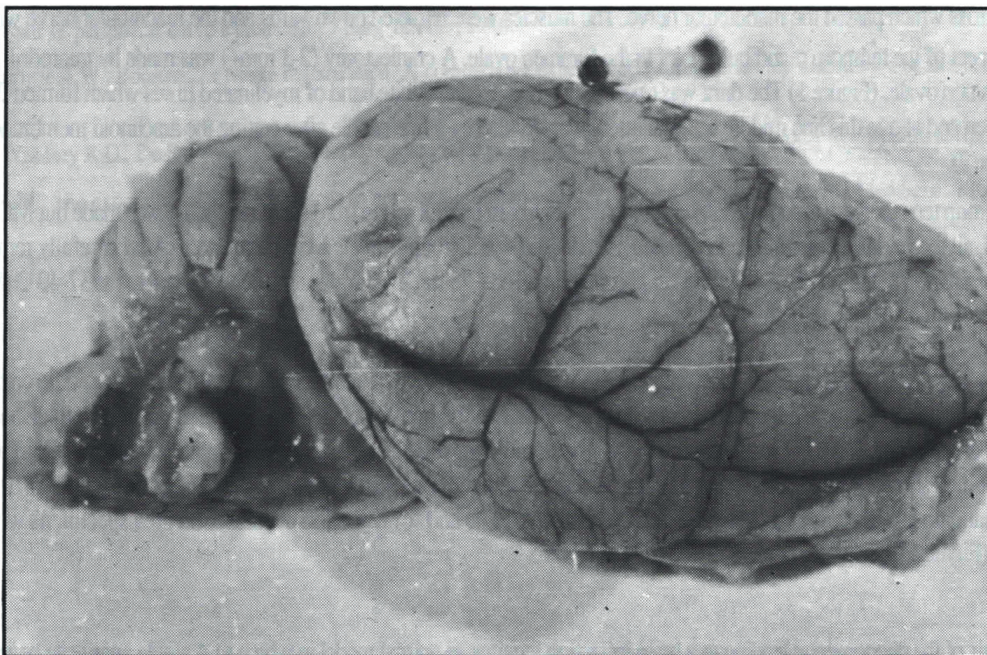


FIGURE 2: THE MIDDLE CEREBRAL ARTERY AND ITS BRANCHES (BLACK INK STAINING)



FIGURE 3: CORONAL SECTIONS OF SHAM GROUP AFTER TTC STAINING. NO AREA OF INFARCTION IS VISIBLE.



FIGURE 4: THE DEMONSTRATION OF THE INFARCTED AREA (LIGHT AREAS)



FIGURE 5: H&E STAINING OF THE INFARCTED AREA (LIGHT AREAS).

primate (6, 12, 13).

Occlusion of the proximal part of the middle cerebral artery in the rat is technically feasible and its histological consequences are consistent. If the operation performed through a smaller exposure, the zygoma and coronoid process are left in place and the temporalis muscle is simply retracted. This operation model was first described in 1981 (4, 15). In the present study the same technique was used without removing the coronoid process of mandibula and arcus of zygoma. After craniectomy MCA was easily found and occluded.

When compared with the cat, dog and primate, the origin of the middle cerebral artery lies relatively further from the optic foramen. For this reason the transorbital approach to the middle cerebral artery used in the former species proved unsuitable in the rat and therefore a subtemporal craniectomy approach was evaluated in this study (4, 6, 15, 11). The anatomy of the arterial supply to the cerebral hemispheres in the rat is essentially similar to that of humans. The ability to produce a consistent focal ischemic lesion in the rodent brain provides a technical approach that is sufficiently reproducible to enable investigation of the pathophysiology of ischemia (4, 15, 16, 17, 18).

The main advantage of rodents has been their relative cheapness when a large number of experiments were necessary. The reproducibility of the lesion that results from proximal middle cerebral artery occlusion in the rat and its clearly demarcated, unilateral distribution makes this model very appropriate for autoradiographic investigations of cerebrovascular function in focal ischemia.

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Nd: YAG LASER IN TRANSSPHENOIDAL OPERATIONS OF PITUITARY TUMORS

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Surgery of pituitary tumors improved by introduction of the microsurgical technique. Despite the improvement of surgical results pituitary tumors still continue to represent a special problem and therefore a search for new surgical techniques goes on (6, 7, 8). This problem is more prominent in cases of adenomas with excessive hormone production which often can not be treated effectively by surgery alone.

Adhesions of pituitary tumors with important structures such as optic nerve or the carotid arteries continue to complicate the radical removal of tumors and attach a high risk to surgery. It is also well known that the control of gross paranchymatous bleeding in cases of large adenomas is inadequate with conventional methods, and rebleeding episodes are not rare. Hence some more improvement of surgery of sellar region would require a technical procedure which permits more radical tumor removal without a higher risk of damaging neighboring structures as well as a better means of bleeding control.

METHOD:

After transsphenoidal approach to pituitary tumor (3), dura of the sellar floor was irradiated with laser prior to opening in order to arrest bleeding from the capsule. The applied power was 10 watts per 1.0 sec duration. Pituitary tumor was then curreted by conventional means. We additionally apply laser to the basal capsule parts as well as the lateral walls of the sella. This laser irradiation caused improvement of bleeding control.

It is well known that Nd YAG energy penetrates more deeply into the target tissue producing a deep thermal effect which results in shrinkage coagulation and necrosis of tissue 4 to 6 mm below the surface (9, 10). One must certainly consider the effect of the laser if it is used in the para and suprasellar region. For this reason we used VEP tests as a complementary test of visual acuity and field. VEP tests are more sensitive than conventional methods (1, 2, 4, 5).

Preoperative and postoperative hormone production and pituitary functions are also evaluated (Table 1-2). There were no early and late postoperative complications that were specifically due to the use of the laser. The result of our initial study on the use of the Nd YAG laser in transsphenoidal pituitary surgery shows that the technique is safe and may permit more radical removal of tumors.

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TABLE 1: PREOPERATIVE VISUAL ACUITY (VA), VISUAL FIELD, VISUAL EVOKED POTENTIAL, AND HORMONE VALUES OF PITUITARY TUMORS AND LASER ENERGY IN JOULES

Case	VA		VF		VEP				Hormon	Laser (Joule)
	R	L	R	L	Amp.		Lat.			
					R	L	R	L		
1. SY	0.9	1.0	CN	CN	6.6	4.6	99	122	4000pg(*)	634
2. MT	0.5	0.3	F	F	10	10	90	98	47ng(**)	481
3. HY	1.0	1.0	CN	CN	-	-	-	-	120ng(***)	267
4. VY	1.0	1.0	F	F	5.4	3.4	96	100	45ng(**)	206
5. NG	1.0	1.0	F	F	6.8	5.8	91	91	156.2ng(***)	226

Amp: Amplitude

Lat: Latency

(*): ACTH

(**): STH

(***) Prolactine

TABLE 2: POSTOPERATIVE VA, VF, VEP AND HORMONE VALUES OF PITUITARY TUMORS

Case	VA		VF		VEP				Hormon
	R	L	R	L	Amp.		Lat.		
					R	L	R	L	
1. SY	1.0	1.0	CN	CN	6.0	5.6	96	98	59.6pg (*)
2. MT	0.5	0.4	F	F	10.2	6.2	93	94	4.0ng (**)
3. HY	1.0	1.0	F	F	-	-	-	-	0.10g (***)
4. VY	1.0	1.0	F	F	8.2	6.4	94	97	4ng (**)
5. NG	1.0	1.0	F	F	6.8	8.8	88	88	19.7ng (***)

Amp: Amplitude

Lat: Latency

(*): ACTH

(**): STH

(***) Prolactine

ANEURYSM OF THE INTRACRANIAL EXTRADURAL PORTION OF THE INTERNAL CAROTID ARTERY PRESENTING AS TRIGEMINAL NEURALGIA: CASE REPORT

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Intracranial aneurysms do not always present with subarachnoidal hemorrhage. They can be found incidentally during cerebral angiography performed for other reasons at a rate of 0.05-2.1 % (21,28), or may be represented by other neurological abnormalities (5, 28).

The fact that aneurysms can cause trigeminal neuralgia has also been reported (15). In this paper we present a patient of trigeminal neuralgia in whom an intracranial mass lesion was detected by CT scanning. At operation an intracranial but extradural aneurysm of the internal carotid artery was found. We believe this is the first such case reported in the English literature.

CASE REPORT:

A 33-year-old woman having left sided lancinating pain of sudden and short duration for 9 months was admitted to our clinic for investigation and treatment on April 29, 1987. She experienced these painful episodes 4-6 times a day and did not benefit from analgesics or Tegretol. Neurological examination revealed a diminished left corneal reflex but was normal otherwise. Computerized tomography demonstrated an enhancing mass at the basal part of the left middle cranial fossa (Fig.1). A left temporal craniotomy was carried out on May 5, 1987. No abnormality of the temporal lobe was found but a bluish colored and pulsating extradural mass was seen in the vicinity of the Gasserian ganglion. The mass was punctured with a small caliber needle and arterial blood was withdrawn. A left sided carotid arteriography was performed just after the operation. Arteriography revealed an aneurysm of the internal carotid artery (Fig.2 and Fig.3). On the next day a temporary clip was applied to the common carotid artery in the neck. The clip was gradually occluded in the ensuing 24 hours with no neurological deficit and was ligated on May 6, 1987. During a follow-up period of over 10 months the patient is free of the trigeminal neuralgia pain and has experienced no additional neurological deficit.

DISCUSSION:

Cerebral aneurysms are usually manifested by headache, subarachnoid hemorrhage or other neurologic deficits such as cranial nerve palsies, visual field defects, motor deficits, epileptic seizures, etc. (5, 17, 20, 21, 28). Sometimes they are incidentally found on angiograms performed for other reasons (21, 24, 28). Trigeminal neuralgia may be caused by intracranial vascular abnormalities, such as vascular loops, or aneurysms. These can be treated by microvascular decompression or by clipping of the aneurysm (5, 8, 9, 10, 15). Anomalous carotid-basilar anastomosis may cause trigeminal neuralgia. This was first suggested by Sutton (1950) and Harrison (1953) and the first case report was presented by Jackson et al. in 1960 (11, 15, 22). A persistent trigeminal artery is one of the three persistent carotid-basilar anastomoses which may be seen in the adult life (4, 6, 7, 1, 15, 17, 26, 27). Although this anomalous vascular relation was first described by Sunderland in 1941 (as quoted by Sutton) Sutton was the first to demonstrate it in a living patient by angiography (22). The two other forms of anomalous arteries are the auditory and the hypoglossal arteries (4, 7, 27). These three embryonic arteries join the internal carotid arteries to the basilar artery in the embryo.

Cases of intracranially extending, extradural internal carotid artery aneurysms arising either in the carotid canal or in the petrous bone or of traumatic origin have been reported by various authors (2, 12, 18, 20, 23), but an intracranial extradural saccular aneurysm of the internal carotid artery presenting as trigeminal neuralgia has not yet been reported.

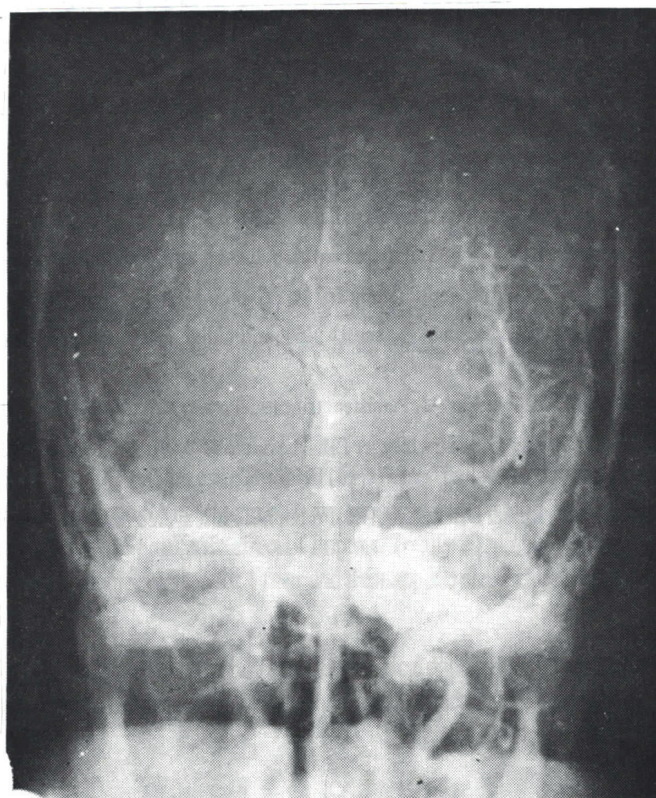
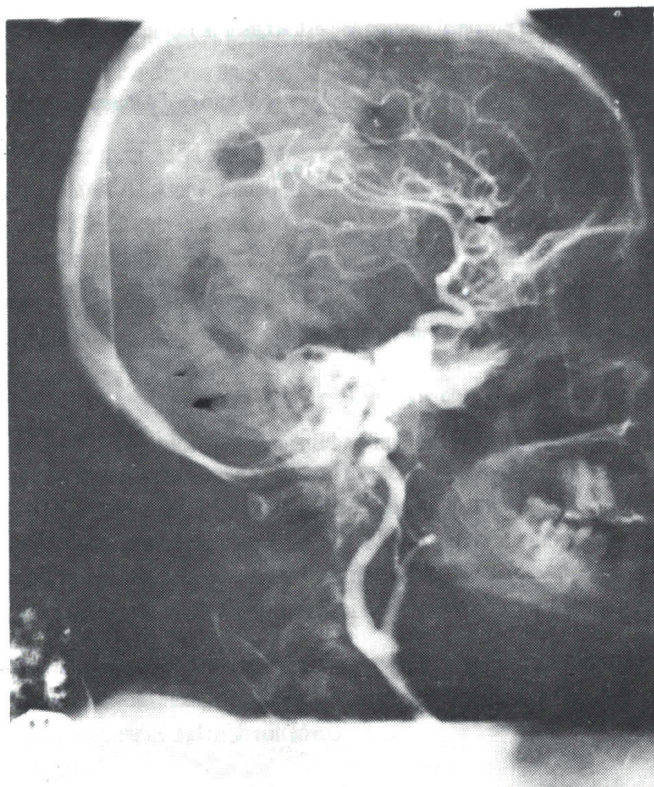
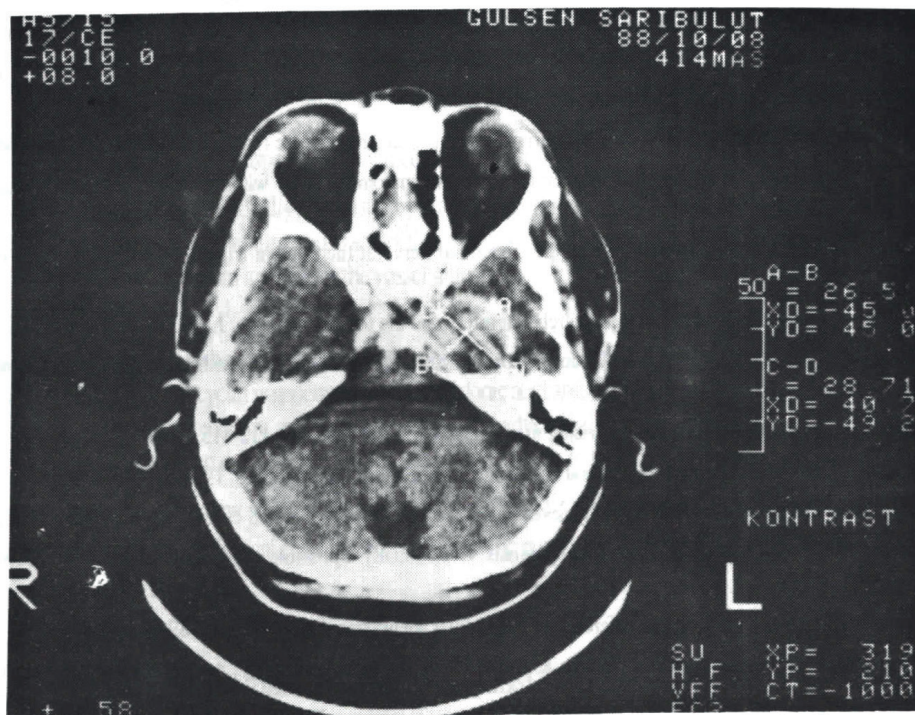
The trigeminal artery in the embryo, usually obliterated when the embryo is 14 mm long (45-day) connects the infraclinoidal portion of the internal carotid artery with the cephalad portion of the basilar artery (11, 26). As stated by different authors, congenital cerebral aneurysms may arise from the weakened points representing the sites of incompletely involuted embryonic vessels (11, 14, 17, 26).

Probably the arterial media defect leading to the formation of the aneurysm found in our case was at the point just before the internal carotid artery penetrated the dura mater. This location is the region where the prementioned embryonic arteries normally arise (4, 6, 12, 14, 23, 26). The close relation of the extradural aneurysm sac with the Gasserian ganglion was the cause of the trigeminal neuralgia in our case because the neuralgic pain disappeared after the ligation of the common carotid artery. This is a rare vascular cause of trigeminal neuralgia which was not reported previously.

We used common carotid artery ligation in the neck for the treatment of the internal carotid artery aneurysm in our case. Carotid artery ligation may be used to treat aneurysms in rare cases (1, 3, 12, 16, 19, 20, 25), although the preferred surgical treatment of an aneurysm is the application of a suitable type of an aneurysm clip across the neck of the aneurysm. It has been concluded that the annual rate of fatal recurrent hemorrhage from an intracranial aneurysm following common carotid artery ligation is in similar magnitude to that of the natural history of conservatively managed ruptured intracranial aneurysms which is about 2% (1). The ligation procedure itself has some significant morbidity and mortality, even in patients with unruptured aneurysms and these figures are about 45% and 17% respectively (1). Common carotid artery ligation also carries the risk of ischemic morbidity either in the early period (15%)

or in the late period (6%) and can cause hypertension and contralateral aneurysm formation (13, 25).

In spite of these rational arguments against managing intracranial aneurysms by common carotid artery ligation this type of management appears to be the method of choice in cases where the aneurysm is inaccessible and/or the neck of the aneurysm is absent or inaccessible (23). In our case, which was treated by simple gradual obliteration and finally ligation of the common carotid artery, no morbidity was detected in the follow-up period and the patient made a remarkable recovery from her symptoms of trigeminal neuralgia.



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EXPERIMENTAL CEREBRAL VASOSPASM: RESOLUTION BY ILOPROST

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Cerebral vasospasm following subarachnoid hemorrhage is a serious clinical condition with unfavorable prognostic significance. Clinical and experimental studies now available suggest that mechanical, chemical and neurogenic factors are responsible for the occurrence of cerebral vasospasm following subarachnoid hemorrhage. In recent years it has become possible to predict which patients are at most risk of developing cerebral vasospasm but it is apparent that intracranial arterial spasm does not have a simple definition. Furthermore its aetiology and pathogenesis are still not well understood and there is no animal model that duplicates all of the key aspects of human cerebral vasospasm.

The selection of spasmolytic agent should, ideally, be based upon a knowledge of the pathophysiological status of the vascular wall and of the spasmogenic agent or influence. In view of the numerous factors that may cause the peculiar state of reactivity of cerebral vessels after SAH, the ideal spasmolytic drug should both relieve the spasm and render the vessel unresponsive to further irritants, whether chemical or mechanical in nature. Various spasmolytic drugs have been tried (21).

Prostacyclin is a powerful vasodilator. It is the most potent endogenous inhibitor of platelet aggregation known. It acts as an antagonist of thromboxane A₂ which is synthesised by platelets. Prostacyclin is generated from arachidonic acid and/or prostaglandin endoperoxide by human cerebral arteries. The rate of synthesis is highest in the vascular endothelium and decreases toward the adventitial surface. Following SAH the synthetic activity of prostacyclin in cerebral arteries decreases especially between day 3 and day 8 (11, 18). This is thought to be responsible at least in part for cerebral vasospasm.

Iloprost has recently been synthesized as a new stable analog of prostacyclin (PGI₂). This new compound has been shown to have a profile of action similar to natural PGI₂ in various pharmacological preparations (1, 2, 20). The purpose of this study is to determine the effect of topical administration of iloprost on experimental vasospasm in rabbits.

MATERIAL AND METHOD:

Ten adult rabbits were used for this experiment. Transclival exposure was carried out through a right submandibular incision. We injected 200 mg luminal IM. and 10 mg diazepam intravenously for anesthesia. The animal was placed on its back. Lateral right submandibular incision was made extending from the mandible to the jugular fossa. Sternohyoid and sternomastoid muscles were retracted and tracheostomy was performed. The intubated trachea and oesophagus were gently retracted laterally with self-retaining retractor, thus exposing the capitus muscle lying on the clivus. Then using the operating microscope, the capitus muscle was then removed by using dental drill and the basilar artery was exposed from the rim of the foramen to the level of the superior cerebellar artery. The dura mater was incised and retracted.

We applied mechanical and electrical stimulus (3) in order to induce vasospasm. Electrical stimulus was rectangular biphasic suprathreshold pulses (10 per sec., 10 msec duration) applied for 10 to 30 seconds consistently. Autologous blood was also the cause of vasospasm. We observed vasospasm while opening the dura because of autologous blood that contaminated the basilar artery. This vasospasm is resolved with 1 g Iloprost in 0.1 ml solution. (1 g/0.1 ml for each trial). We observed that 3 minutes later vasospasm resolves macroscopically.

The basilar artery was photographed after induced vasospasm and 10 minutes after application of Iloprost. The colored photographs were used for measurements. The diameter of the basilar artery and the reference were measured with a millimeter ruler. From these measurements actual vessel diameters are calculated in microns.

RESULTS:

Spastic diameters of basilar artery and diameters after topical application of Iloprost (1 g / 0,1 ml) are listed in table 1. One measurement was made in four rabbits. It was impossible to produce a secondary spasm by mechanical electrical stimulus and SAH. In six rabbits we produced a secondary spasm by the method described. But it was also impossible to produce a third spasm. This might be due to profilactic effect of Iloprost. Totally 20 minutes of Iloprost application makes the vasodilatation irreversible. We washed the basilar artery with isotonic solution for 1 hour and then applied electrical, mechanical stimuli and fresh autologous blood for 1 hour but we could not achieve spasm.

The mean diameter of spastic basilar artery is 291.75 ± 30.67 and dilated vessel is 778.37 ± 20.9 . Our data shows that after topical application of Iloprost the basilar artery diameter significantly increases ($P < 0.001$). In addition dilated basilar artery did not respond to vasoconstrictor effects such as mechanical, electrical stimulus and fresh autologous blood.

DISCUSSION:

Cerebral vasospasm presents a challenging clinical problem that is in urgent need of solution. Cerebral arteries are sensitive to almost any change in their surroundings. Mechanical trauma, including scrubbing, pulling or pinching, electrical stimulation (3, 17), topical application of chemicals (8, 9, 10) such as barium chloride, iron compounds, serotonin, prostaglandins, angiotensin and contact with blood (5, 13, 14, 16, 17, 18, 19) induces significant constriction of cerebral arteries. However, to establish that some particular stimulation is responsible for cerebral vasospasm, it is not enough to show its presence at subarachnoid hemorrhage and ability to induce severe vasoconstriction.

In experimental delayed vasospasm, formation of prostacyclin (PGI₂) in canine basilar artery has been found to be significantly decreased (11, 18). The synthetic activity of PGI₂ in the artery exposed to subarachnoid blood injection had diminished remarkably by days 3 and 8. This diminution of PGI₂ synthesis in the cerebral artery may be involved in the pathogenesis of cerebral vasospasm. Sasaki and Boulin et al. have suggested that, decreased synthesis of PGI₂ in the vessel wall may be the cause of vasospasm for the following reasons.

First it is known that PGI₂ is mainly synthesized in the endothelial cell (4, 6, 7) that prevents platelet adhesion and aggregation and that it dilates vascular smooth muscle (15) second PGI₂, significantly dilates the cerebral artery that is actively constricted either by serotonin, PGF₂ or thrombin (5, 11). The vasodilatory action of PGI₂ extends to other vasoconstrictive substances, such as PGD₂, PGE₂, PGA₂ and oxyhemoglobin (11).

Since PGI₂ acts to antagonize the vasoconstrictive actions of such agents and prevents platelet adhesion and aggregation, it appears that PGI₂ constitutes an indispensable protective mechanism that acts against the occurrence of vasospasm following SAH. Doves showed that vessels normally contain prostacyclin receptors and that dilatation occurs when they are stimulated. In experimental studies constant infusion of prostacyclin by automatic injection was found to be preferable, because the half life-span of prostacyclin is very short (12). The short half life of prostacyclin makes its routine use difficult. In order to overcome this difficulty, more stable metabolite of prostacyclin with longer half life must be found.

Iloprost (ZK36374) is a new stable analog of prostacyclin. In various pharmacological preparations Iloprost showed a profile of action similar to natural PGI₂ (1, 3, 20). In our experiment iloprost dilated spastic basilar artery. This mode of action was also similar to PGI₂. Iloprost is a stable analog so its action on cerebral vessels takes longer time than PGI₂. It seems that Iloprost relieve the spasm and render the vessel unresponsive to further irritants.

TABLE 1: DIAMETER OF SPASTIC AND DILATED BASILAR ARTERY AFTER TOPICAL APPLICATION OF ILOPROST

Rabbit	Spastic Diameter	Dilated Diameter
D1D1	450	800
R2D1	342	800
R2D2	266	535
R3D1	266	800
R3D2	160	800
R4D1	400	800
R4D2	320	800
R5D1	266	720
R6D1	200	800
R6D2	266	933
R7D1	133	800
R7D2	533	800
R8D1	400	800
R8D2	400	800
R9D1	133	666
R10D1	133	800
Mean	291.75±30.67	778.37±20.9

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A CASE OF MECKEL GRUBER SYNDROME ASSOCIATED WITH POSTERIOR FOSSA CYST, CREBELLAR HYPOPLASIA AND HYDROCEPHALUS WHICH IS DIAGNOSED IN UTERO, WITH CT AND POSTMORTEM EXAMINATION

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CASE REPORT

A 28 years old woman, was admitted to obstetrics clinic at the 33 rd gestational week because ultrasonography revealed a hydrocephalic fetus. Gestation was uncomplicated till this week. In the obstetric history she had a 38 weeks stillbirth with ambiguous genitalia, polydactyly, anencephaly and meningomyelocele following three healthy live birth from nonconsanguinous marriage. The AFP level was 55 ngr/dl that was in normal limits for this gestational week. Meckel Gruber Syndrome was suspected prenatally with the history of the previous malformed stillbirth, oligohydramnios, breech presentation and USG findings of macrocrania, hydrocephaly, marked enlarged abdomen, hepatomegaly and polycystic kidneys.

The termination of pregnancy was performed and the malformed female fetus died at the induction of labor, stillbirth was examined with USG and CT. The postmortem examination of the fetus morphologically revealed: The weight 3.400 gm, the length 51 cm, the head circumference was 39 cm, chest circumference 30 cm, the abdominal circumference 41 cm. She had a macrocrania with edematous skull skin, low set right auricula, left hypoplastic mandibulae with micrognathia, cleft palate and tongue, hypotelorism, flattened nose and the fold arising from the inner canthus swept downward and laterally below the eyes. The thorax was hypoplastic, the abdomen enlarged with renal masses. Both hands and feet had postaxial polydactyly and simian line and clinodactyly at the left hand (Fig.1).

The postmortem X-ray demonstrated short and deformed ribs on the right side and enlarged abdomen (Fig.2). The chromosome analysis was normal, 46 XX. At the CT, foramen magnum was dilated and the fourth ventricle could not be detected. Behind the fourth ventricle there was a cystic mass of CSF density which elevated tentorium and displaced mesencephalon anteriorly and looked like Dandy-Walker malformation (Fig.3), dilated cervical and thoracic vertebral canal, hepatomegaly, bilateral renomegaly and minimal ascites were detected.

The postmortem examination demonstrated that the lungs were unexpanded, the heart and the great vessels were normal. The gross appearance of liver was normal but microscopically had bile ducts proliferation and hepatic fibrosis (Fig. 4, 5). The brain was grossly malformed with flat gyri. The lateral and third ventricles were extremely dilated. There was a severe cystic dilatation of the fourth ventricle and part of this cystic dilatation was covered by only leptomeninges. Approximately the diameter of the cyst was 4 cm. and communicated with the ventricular system. Therefore, there was a posterior fossa cyst and hypoplasia of the cerebellar vermis which were associated with hydrocephaly and all these malformations were recognized as Dandy-Walker Syndrome. No stenosis or obstruction of aqueduct of Sylvius was noted but the foramen Magendie was absent and Luschka was closed. The thickness of brain was reduced to less than 1 cm (Fig.6). There were corpus callosum agenesis, cerebellar hypoplasia and absence of the olfactory bulbs (Fig.7).

The right kidney weighed 300 gm and sized 13x7x5 cm on section. It was containing several cysts. The most prominent was 0.5 cm in diameter. The left kidney was 270 gm and also contained several cysts with a major cyst measuring 0.6 cm. The ureters and bladder were normal. Microscopically, cystic tubules and very scanty glomeruli were noted at the cortex of kidney (Fig.8) and cystic collecting tubules of varying sizes surrounded by dense fibrous stroma at the medulla.

DISCUSSION:

This syndrome was first described by Meckel in 1822, in which polycystic kidneys, polydactyly and occipital encephalocele were present. Gruber (1934) referred to it as "dysencephalia splanchno cystica" depending on the combinations of CNS, somatic and splanchnic malformations. The mode of transmission of this rare syndrome is an autosomal recessive gene (Mecke and Passarge 1971) and affected infants are either stillborn or die soon after birth. Every affected fetus should be examined carefully for the identification of such an autosomal recessive condition which alters the genetic counselling for a future pregnancy. It is considered to be a rare condition, more prevalent among Jews, 1 in 50.000 (Fried 1973) and also been recorded in Turkish literature (Öztürk et al 1979 and Tunçbilek et al 1980).

The diagnostic criteria for Meckel syndrome requires at least two of the triad of occipital encephalocele, polydactyly, cystic kidneys and normal chromosome constitutions. Fifty seven percent of cases have all the three major abnormalities (Seller 1981). Polycystic dysplasia is thought to be the only constant sign in the Meckel syndrome (Fraser and Lytwyn 1981). Cystic changes in renal parenchyma were present in every case. Some cases had only macroscopic cysts but others had huge polycystic kidneys. Histologically the cysts were at the proximal tubules, distal tubules or in the renal medulla. Ultrasound examination is a noninvasive method for prenatal detection of kidney anomalies (Karjalainen 1981).

The major CNS abnormalities are occipital encephalocele and microcephaly. Encephalocele exists usually in the four-fifth of the cases. Apart from

encephalocele there may be varying degrees of hydrocephaly, arhinencephaly, absent olfactory bulbs and optic nerves. CNS findings of our case were cerebellar hypoplasia, hydrocephaly with Dandy-Walker malformation and agenesis of bulbus olfactorius. Hydrocephaly in Meckel syndrome was reported by Simopoulos (1967) at three cases and Walbaum (1967) at two cases but we couldn't find a case as ours at the literature. Our case had no open defect, therefore maternal AFP level was normal. The syndrome is increasingly being recognized among fetuses in mid-second trimester following prenatal diagnosis by elevated amniotic fluid and maternal alfa-fetoprotein levels (Seller 1978).

Finally, the interesting point of view of our case was the first Meckel syndrome diagnosed prenatally from our country. Furthermore, associated with Dandy-Walker Malformation (hydrocephalus, cyst of the posterior fossa and cerebellar hypoplasia). As far as we know these combinations have not been reported in the previous literature.

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NEUROFIBROMAS OF THE SPINAL CORD (A CLİNICAL SURVEY OF 30 CASES)

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Neurofibromas account for 23 % of all spinal tumors (8). Treatment of neurofibromas can be particularly satisfying for the surgeon because of their benign nature and the highly successful results of their removal (9). The tumor is of historical importance in neurosurgery because the first intraspinal tumor removed by Lecat in 1753 was a neurofibroma (8).

In this paper, we present 30 cases with spinal neurofibromas from Hacettepe University, Department of Neurosurgery between the years 1965 - 1986, with clinical, radiological and therapeutic features discussed and compared with literature.

MATERIAL AND METHOD :

30 patients were diagnosed and treated for spinal neurofibroma between the years 1965 - 1986. All cases were treated surgically and histopathological verification was made. This includes all cases of neurofibromas that occurred below foramen magnum. Results were characterized primarily by motor responses and particularly by walking. Five motor categories were 1) Normal, 2) Walking with assistance, 3) Strength greater than gravity, 4) Strength less than gravity and 5) Paraplegic. We evaluated the patients as improved or worsened when they crossed to a different motor category. Sensory examination, bowel and bladder function and pain were also examined for following evaluation.

RESULTS :

Twelve of the patients were men and eighteen were women. The patients ranged from 13 to 76 of age at the time of diagnosis. Table I summarize the sex and age distribution. Table II shows the presenting symptoms of the patients. The most prominent complaints of the patients were motor weakness and pain at lower extremities in 13 (47 %) of cases, neck pain in 7 (21) of cases. Duration of symptoms were ranging between 3 months to 8 years. Neurologic examinations are shown at table III. Paraparesis was present in 10 of the cases and monoparesis in 12. 4 patients were quadriparetic before the operation. Neuroradiologic evaluation was performed for all patients and myelography revealed total block in 21 (70 %) of cases and most common site was thoracic spine in 18 (60 %) of cases. The results of these studies were summarized at table IV. The optimal treatment for spinal neurofibroma is total excision of the neurofibroma and than reclosure of dura mater. This was the procedure in our series and was accomplished in 70 % cases. The operating microscope was routinely used after 1976. All patients were evaluated at the first postoperative follow up at early postoperative period and at 1,5 month and from long term following averaging three years. The postoperative neurological examination of these cases revealed as excellent in 18 (60 %), good in 9 (30 %), 1 unchanged and 2 of the cases were dead because of respiratory insufficiency after operation. These two cases had neurofibroma at the high cervical cord level. The results of the postoperative neurological examination are summarized at table VI.

DISCUSSION :

Neurofibromas arise from the roots at the various segmental levels of the spinal cord (2,5), originate from schwann cells along nerves near the nerve - nerve root junction, which is in the intervertebral foramen (6,7). Neurofibromas presents as intradural extramedullary tumors. Their direct involvement in the root often produces radicular pain and sensory changes in spinal neurofibromas. Neurofibromas are usually intradural but can be extradural or both (3), rarely intramedullary (10). A series, studied at the Mayo clinic revealed a 16.5 % incidence of complete or partially extradural tumors. Tonnis reported 82 spinal neurinomas of which 14.1 % were extradural and 12.8 % both extradural and intradural (8). In our series only 6.5 % of them were both extradural and intradural, 25 % were extradural. It has been reported that the intradural space should be explored in the presence of any extradural neurofibroma because they can cross from extradural to intradural in such intimate relation to a nerve root that it may not appear thickened.

Pain was the most frequent complaint in patients and constitute the only symptom in 28 % of the cases. Their pain was most often characterized as radicular corresponding in location to the root subsequently demonstrated to be involved by the tumor.

The standard surgical technique is to incise the dura mater at one side of the tumor and remove it without manipulating the spinal cord. It is important not to manipulate the tumor back and forth in the bed. Excellent neurosurgical results were achieved by using microscope and microsurgical techniques. Often these tumors are cystic and should be aspirated or opened decompressing them to reduce stress on the adjacent cord. Sacrifice of a root is usually necessary, but attention should be paid to sparing adherent vessels that may provide an important blood supply to the spinal cord (1,3,7).

Several comparisons with intraspinal meningiomas have been published (6,8). The most prominent difference is spinal cord compression and seem to be somewhat less common in spinal neurofibromas than in spinal meningiomas.

Spinal neurofibromas are seen in this series as a tumor that can be attached surgically to a very good effect and long postoperative term also shows that patients improve many months after removal of the tumor to the point of substantial recovery.

AGE GROUP	FEMALE	MALE	TOTAL
10 - 20	4	-	4
21 - 30	4	5	9
31 - 40	3	4	7
41 - 50	7	2	9
51 - 60	-	-	-
61/	-	1	1
TOTAL	18	12	30

TABLE I

SYMPTOMS AND DURATION	0 - 6 mth	7 - 12 mth	1 year
Neck Pain	6	1	-
Upper Ext. Pain	3	-	-
Paraparesis And Pain	8	3	2
Quadriparesis And Pain	4	2	-
Sphincter Dysfunction	5	1	-
Paresthesia	-	2	1
Back Pain	2	1	5
Lower Ext. Pain	-	-	4

TABLE II

FINDINGS	NO. OF CASES
Monoparesis In Upper Ex.	3
Monoparesis In Lower Ex.	9
Paraparesis	10
Hemihypesthesia	2
Hypesthesia	19
Quadriparesis	4
Reflex Pathology	12

TABLE III

MYELOGRAPHIC FINDINGS	NO. OF CASES
Total Block	21
Partial Block	9
LEVELS	
Cervical	7
Thoracal	18
Lumbar	5

TABLE IV

SURGICAL PROCEDURE		NO. OF CASES
Laminectomy	2 Level	4
	3 "	19
	4 "	7
OPERATION		
Total Tumor Excision		21
Subtotal Tumor Excision		9

TABLE V

SURGICAL RESULTS	NO. OF CASES
Excellent	18
Good	9
Unchanged	1
Reoperation	2
Exitus	2
TOTAL	30

TABLE VI

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POSTOPERATIVE LUMBAR REGION INFECTIONS AND THEIR CT FINDINGS

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Tumbull presented the first series of three patients of postoperative disc space infection in 1953 (11), and discitis has become a recognized clinical entity. Recurrent pain in patients who have had surgery for lumbar disc herniation causes difficulties in diagnosis and treatment. A number of reasons may cause recurrent back pain such as; recurrent disc herniation, postoperative facet disturbance, incomplete or incorrect surgery, air in the thecal sac, postlaminectomy pseudomeningocele, postoperative extradural hematoma, extensive scar formation and intervertebral discitis (3,8,9,10,12).

The interval between the beginning of the symptoms and the time of operation is one of most important points in making a correct diagnosis. Discitis and local infection are the main complications within the early postoperative period (2,4,5,6,7).

In various studies, the incidence for postoperative intervertebral discitis and wound infection have been reported below 1% and 1.7-9.7% respectively (2,6). Since these complications are rare, diagnosing the problem may be difficult. When clinical symptoms arouse a suspicion of infection, it may be difficult to localize the infection because in the early postoperative period plain X rays, myelography and bone scintigraphy may not reveal any pathologies. CT scanning has proved to be the best method in diagnosing lumbar region infections in the early postoperative period (9).

In this preliminary report CT findings of infections at the operation sites are discussed.

MATERIALS AND METHOD :

During the year of 1987, 157 patients were operated for lumbar disc herniation (LDH) in HUTF and 8 patients developed local infections and/or discitis. Table 1 shows the age, sex and the original site. Results of early postoperative period were good for all. CT examination were made to the 7 of the patients at the time of the onset of symptoms. CT scanning were made with a third generation device and 3 or 4.5 mm. thick slices were obtained. All the patients were obtained. All the patients were given IV contrast material with continuous drip infusion.

RESULTS :

Table II shows the interval between the original surgical procedure and symptoms being 5 to 22 days. The first clinical symptom was fever in 5, back pain in 7, and pus drainage in all of the 8 patients. 7 of the patients were evaluated by contrast enhanced CT scanning. In all examinations there was a decrease in muscle density, fat plane obliteration and enhancement which was more prominent than other soft tissues. 3 patients presented a hypodense, capsular opacifying lesion which was an abscess in the paraspinal muscles and situated close to the laminectomy site. In cases, infectious collection penetrated into the epidural, intervertebral disk space. Disc density was found to be decreased in 3 cases. In 1 of these patients, disc density was 8 HU and after enhanced, riced to 30 HU, approximately the same value for the other 2. The disc enhancement was nonhomogenous in all 3 of the patients. 2 of the patients showed early degenerative changes at their vertebral endplates. 3 patients had lytic changes. (Table III)

Table IV shows the average ERS and WBC preoperatively and at the time of onset of symptoms.

3 of the patients were reoperated and pus was drained from paravertebral soft tissues and intervertebral disc spaces. In these patients the operative findings confirmed the CT findings.

In 5 patients debridement and seconder closure was performed.

The cultures were positive in 4 patients. with staph. coag. (+)

All of the 8 patients were placed on bed rest and analgesics, antibiotics were administered.

DISCUSSION :

Burton et al. have reported the incidence of lumbar spine operational failures to be about 30% (10). Intervertebral discitis and paravertebral soft tissue infections are possibilities which must be kept in mind in the differential diagnosis (1,5,6,9). This is especially true if after a short and painless postoperative period, severe backache and spasm occurs. Various authors have reported the incidence of postoperative discitis to range from 0,73% to 3% (2,5,6). The rate of wound and soft tissue infections were reported to be below 5% (2,5). Thibodeau has demonstrated that in patients with disc space infection, only 8% had evidence of wound infection (5). In our serie, the interspace infection rate was found to be 1.2% and paravertebral soft tissue and wound infection rate was 3.8%. These rates are similar to those found in other studies.

Because of the variety of conditions simulating the above pathologies a through clinical and laboratory assesment and a complete neurological examination of the patient is necessary to come to a correct diagnosis. In this way, these infections can be differantiated from other causes of failed back surgery syndrome. Unfortunately, most of the available clinical and laboratory methods fail to show the exact location of the infection in the early postoperative period (9). Radiological changes appear late in the course of the disease. The first detectable changes can be seen at least 30 days after the operation and usually not before 4

to 6 weeks after the first symptoms appear (1,4). This interval is an important period of time which must not be lost without treatment (1,7) Especially if there is no local changes over the incision and there is no fever, these conditions may be overlooked.

With the aid of CT, we have the opportunity to examine the operation site effectively without given the patient who already had back pain and muscle spasm, any additional discomfort. With CT, one can obtain excellent images of the epidural and paraspinal regions, as well as the vertebra and disc, and see whether or not there is involvement with an infections process in this areas (9).

CT can demonstrate infectious or other forms of collections at the operation site. Also the paraspinal, epidural and intervertebral disc spaces can be evaluated quite accurately (1,7). A smooth margined, hypodence lesion with capsular enhancement is in concordance with abscess formation. Aided with clinical and laboratory findings, this lesion can be easily differentiated from hematoma and scar formation. If it is still suspicious CT guided biopsy can be made to obtain histopathological material.

Recurrent disc herniation has typical CT characteristics, therefore should have already been excluded from differential diagnosis (8, 10,12).

A decrease in disc density and nonhomogenous enhancement within the disc are quite uncommon findings and it is proven surgically that they represent interspace infection.

Vertebral end - plates may be involved in the infectious process. Irregularities and destructions in cortices can be seen at a quite early period with CT (9). If possible, it is very useful to evaluate the patients, preoperative or early postoperative CT scanings of the same region in order to rule out osteomyelitis of the vertebrae.

In conclusion, postoperative infection of the lumbar spine is a rare complication (1 - 4 %), but if this complication arises, early diagnosis is crucial in starting the appropriate therapy.

In making a diagnosis, CT is the method of choice because it gives the most useful information about the operation site compared with other imaging modalities and has the advantage of being a noninvasive method.

PATIENTS	AGE	SEX	OPERATION	EARLY POSTOP RESULTS
I	52	M	DISCECTOMY L ₄₋₅ BILAT.	GOOD
2	42	M	" L ₄₋₅ L.	"
3	45	M	" L ₄₋₅ L.	"
4	60	M	" L ₄₋₅ L.	"
5	46	M	" L ₄₋₅ BILAT	"
6	46	M	" L ₄₋₅ BILAT L ₅ -S _I "	"
7	38	F	" L ₄₋₅ R.	"
8	42	M	" L ₄₋₅ L.	"

TABLO I

P ATIENTS	FIRST CLINICAL SYMPTOM		INTERVAL BETWEEN ORIGINAL SURGICAL PROCEDURE and SYMP.	TREATMENT		DEBRIDEMENT-
	FEVER/BACK PAIN/PUS DRAINAGE	+		REOPERATION/SECONDAR CLOSURE/ANTIBIOTICS	+	
I	+	+	7 DAYS	-	+	+
2	+	+	I7 "	-	+	+
3	-	+	I8 "	+	-	+
4	+	+	5 "	-	+	+
5	+	+	7 "	-	+	+
6	-	+	22 "	+	-	+
7	-	-	I7 "	+	-	+
8	+	+	7 "	-	+	+

TABLE II

PRESENTS	IVD SPACE	EPIDURAL SPACE	PARASPINAL REGION	CT DIAGNOSIS
1	NORMAL	NORMAL	STRUCTURAL DEFORMATION AT M.ERECTOR SPINA FACIAL PATHOLOGIC ENHANCEMENT	FACIAL AND SUBCUTANEOUS AT L3 LEVEL
2	NORMAL	ENHANCEMENT IN LEFT EPIDURAL SPACE	PATHOLOGIC ENHANCEMENT OF M.ERECTOR SPINA	SOFT TISSUE INFECTION IN LEFT L4-5 LEVEL
3	DENSITY: 33 H.U. PATHOLOGIC ENHANCEMENT WITHIN THE DISC	PATHOLOGIC ENHANCEMENT CLOSE TO THE LAMINECTOMY DEFECT	HYPODENSE AND CAPSULAR ENHANCED LESION IN LEFT M. ERECTOR SPINA	AN ABSCESS IN THE LEFT PARASPINAL MUSCLES L4-5 DISCITIS
4	NORMAL	NORMAL	STRUCTURAL DEFORMATION AT M.ERECTOR SPINA	SOFT TISSUE INFECTION IN LEFT L4-5 LEVEL
5	M.ILIOBOSAS - L4-5 DISC BORDER COULD NOT BE DEFINED	NORMAL	STRUCTURAL DEFORMATION AT RIGHT M.ILIOBOSAS	INFECTION IN RIGHT M.ILIOBOSAS
6	DENSITY: 8 H.U.(30 H.U.AFTER CONTRAST NON HOMOGENOUS ENH.	HYPODENS, CAPSULAR ENHANCED LESION IN LEFT EPIDURAL	4x2 , HYPODENSE LESION AT LEFT PARASPINAL MUSCLES	LEFT PARASPINAL ABSCESS L4-5 DISCITIS
7	DENSITY : 34 H.U. NONHOMOGENOUS ENH.	PATHOLOGIC ENH. AT LAMINECTOMY SITE	HYPODENSE LESION IN RIGHT M.BIFIDUS	ABSCESS IN LEFT PARASPINAL L4-5 DISCITIS

TABLE III

LABORATORY FINDINGS		
PATIENTS	GRAM STAIN EXAM.	CULTURE
I	Gr (+) COCCI	Q
2	PMN L	STAPH .Coag (†)
3	Gr (+) COCCI	Q
4	PMN L	STAPH .Coag (†)
5	PMN L	STAPH .Coag (†)
6	PMN L	Q
7	PMN L	STAPH .Coag (†)
8	Gr (+) COCCI	Q

	AVERAGE ESR	AVERAGE WBC
PREOPERATIVE	2Imm/hr	5500/mm ³
AT THE TIME OF ONSET OF SYMPTOMS	87mm/hr	10300/mm ³

TABLE IV

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