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The Far Lateral Approach for Intra-Dural Anteriorly Situated Tumours at the Craniovertebral Junction

Kraniovertebral Bileşke Anterioruna Yerleşmiş İntradural Tümörlere Far Lateral Yaklaşım

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ABSTRACT

AIM: To assess the efficacy of the far lateral approach, without drilling of the occipital condyle, in the management of anterior intradural tumors at the craniocervical junction.

MATERIAL and METHODS: Ten patients suffering from foramen magnum tumors were operated upon via the far lateral approach without drilling of the occipital condyle. All patients underwent postoperative CT scan of the brain. An MRI and CT of the craniocervical junction were done 3 months postoperatively to assess the extent of tumor and bone removal respectively.

RESULTS: The far lateral approach was found adequate for complete excision in eight out of ten cases of foramen magnum tumors. In the remaining two cases, the tumors were found adherent to the brain stem so complete excision was not done.

CONCLUSION: The far lateral approach (without drilling of the occipital condyle) proved adequate for excision of most cases of anteriorly situated foramen magnum tumors.

KEYWORDS: Foramen magnum tumors, Far lateral approach, Craniocervical junction tumors, Transcondylar approach, Anterior foramen magnum tumors

ÖZ

AMAÇ: Kraniovertebral bileşkede foramen magnumun anterioruna yerleşmiş tümörlerin oksipital kondilin dirillenmeden çıkarılmasının etkinliğinin araştırılması.

YÖNTEM ve GEREÇLER: Foramen magnum tümörü olan 10 hastada oksipital kondil dirillenmeden far lateral yaklaşımla tümör rezeksiyonu yapıldı. Tüm hastalara ameliyat sonrası beyin tomografisi çekildi. Ameliyattan 3 ay sonra ise, tüm hastalara kraniovertebral bileşkenin manyetik rezonans görüntülemesi ve tomografisi çektirildi. Çekilen filmlerde çıkarılan kemik doku ve rezidü tümör dokusu araştırıldı.

BULGULAR: Foramen magnum tümörü olan 10 hastadan 8'inde far lateral yaklaşımla tam tümör çıkarılması sağlandı. Kalan 2 vakada ise tümörün beyin sapına yapışık olması nedeni ile tam olmayan rezeksiyon yapıldı.

SONUÇ: Foramen magnumun anterioruna yerleşmiş tümörlerde Oksipital kondil drillenmeden yapılan far lateral yaklaşım vakaların çoğunluğunda yeterli rezeksiyon yapılmasını sağlamıştır.

ANAHTAR SÖZCÜKLER: Foramen magnum tümörleri, Far lateral yaklaşım, Kraniovertebral bileşke tümörleri, Transkondiler yaklaşım, Anterior foramen magnum tümörleri

INTRODUCTION

The craniocervical junction extends from the lower clivus cranially to C2 caudally. It is limited laterally by the occipital condyles, the jugular foramina and the hypoglossal canals (9). A variety of tumors can occur at the anterior aspect of this area. Tumors in such locality are difficult to excise because they have a close relation with the lower cranial nerves, the vertebral arteries and the brain stem (22,26). In many cases the brain stem is stretched over these tumors and is pushed backward making the midline posterior approach inconvenient to remove them adequately.

Although Crockard in 1993 (8) described the anterior approach through the oral and nasal cavities, many surgeons realized that this is not the ideal approach for anterior intradural tumors of the craniocervical junction. The anterior approach has many disadvantages. The operative field is deep, the lateral extension is limited and there is an increased risk of cerebrospinal fluid leak with the possibility of post-operative meningitis (8,25). Accordingly the posterior and posterolateral approaches became a logical alternative to the anterior approach.

The posterolateral approach is better than the posterior approach as it minimizes the retraction on the spinal cord and improves the visualization of the anterior aspect of the brain stem. There are two major modifications of the posterolateral approach. In one of them, the lateral occipital

condyle is removed partially or completely and this is called "the transcondylar approach". In many cases the condyle is untouched and this is called the "far lateral approach".

One of the major advantages of the far lateral approach is the ability to extend it according to operative requirement into the retrocondylar, paracondylar, supracondylar, partial and complete trans-condylar approach (15,20,23,26,27). Other significant advantages of the far lateral approach are the improved angle of visualization of the area ventral to the lower brain stem, access to intra- and extradural tumors, control of the epsilateral vertebral artery, safer and better development of the interface between the brain stem and the tumor. It also offers better reconstruction option of the cranial base to minimize the chance of development of cerebrospinal fluid fistula (22).

In the present article the far lateral approach was found adequate to treat 10 patients with different pathologies anterior to the neural axis. Drilling of the occipital condyles was not found necessary in any of the cases.

MATERIAL and METHODS

Ten patients suffering from foramen magnum tumors were operated upon by the author in the last 3 years. All patients underwent thorough neurological, laboratory and radiological examination. The radiological examination included MRI of the craniocervical junction. In a recurrent case, CT angiography was obtained to visualize the vertebral arteries. All patients underwent postoperative CT scan of the brain. An MRI and CT of the craniocervical junction were done 3 months postoperatively to assess the extent of tumor and bone removal respectively.

Surgical procedure

The patient is put in the park bench position with the dominant side of the tumor upwards. A roll is placed under the axilla. The dependent shoulder is foam padded and taped to the Mayfield. The head of the patient is flexed so that only two fingers can be put between the chin of the patient and upper part of the sternum. The head is slightly tilted laterally (about 30 degrees) towards the dependent shoulder. The upper shoulder is pulled by adhesive tape downwards to move it away from the field. A roll is put between the knees and the patient is secured to the table by straps and taps.

A hockey stick skin incision is made. The vertical limb is started 7-8 cm below the mastoid process and is extended cranially along the posterior border of the sternocleidomastoid muscle. The transverse process of the atlas can be palpated along the vertical limb just below the mastoid tip (Figure 1). At the base of the mastoid, the incision is carried medially just below the superior nuchal line. This transverse limb is carried medially up to the midline. The skin and the muscles superficial to the muscles of the suboccipital triangle are reflected as a single layer. The posterior arch of atlas is exposed. A small cuff of muscle and fascia is left attached to the superior nuchal line for closure.

Figure 1: Hockey stick skin incision. The vertical limb is started 7-8 cm below the mastoid process.

The posterior arch of the atlas is palpated. The muscles are dissected off the arch of atlas along the inferior surface. Care should be taken as the vertebral artery lies above the superior surface of the posterior arch of the atlas. The posterior atlantooccipital membrane is identified medially. It blends with the periosteum covering the C1 lamina and lateral mass creating an anatomic plane for extraperiosteal dissection from the spinous process to the lateral mass (28). The vertebral artery is identified and dissected from the posterior arch of the atlas. In nine cases the artery was found easily above the arch of C1. In the tenth case, the vertebral artery arched more posteriorly and was found at a superficial plane to C1 arch.

The posterior arch of the atlas is removed with rongeur (Figure 2A,B). A craniectomy is done starting at the lip of the foramen magnum and extending to the midline and as far laterally as possible. The dura is opened by a curvilinear incision based laterally. This incision passes medial to the point of entry of the vertebral artery. This dural flap is usually reflected on its base. Further dural incisions are often needed to increase the exposure. The tumor is found between the vertebral artery and the brain stem. The lower cranial and the upper cervical nerves are usually stretched over the tumor. The first dentate ligament is identified and cut. Working between the nerves, the tumor is debulked and removed. After excision of the tumor the contralateral vertebral artery is often seen. Hemostasis is done and the dura is closed in a watertight fashion whenever possible.

RESULTS

Ten patients were operated upon. They were 8 females and 2 males. The age varied from 30 to 52 years with an average of 41.4 years. The main presenting symptom was gradual progressive weakness with gait disturbance (100%) In one case the weakness progressed rapidly as the patient became pregnant. Other presenting symptoms included neck pain (40%), swallowing problems and change in voice (30%) and headache (20%).

Six of the 10 patient were unable to walk. The average motor power was II in two patients, III in 4 patients and IV in 4 patients. Five patients showed signs of bulbar affection on examination. Two patients showed weakness of the hypoglossal nerve. One patient showed weakness of the spinal accessory nerve.

The tumor was approaches from the right side in 6 cases and from the left in 4 cases. In one case of neurofibromatosis I the incision was extended down to C4 where another lesion at C4 level was removed. The operative time was between 6-10 hours with an average of 8.6 hours. Total removal of the tumor was achieved in 8 cases (Figure 3A,B) with one near total excision and the last was sub totally excised.

Pathologically, six cases were meningiomas, 3 schwannomas and a case of hemangiopericytoma. All schwannomas were totally excised together with the case of hemangiopericytoma.

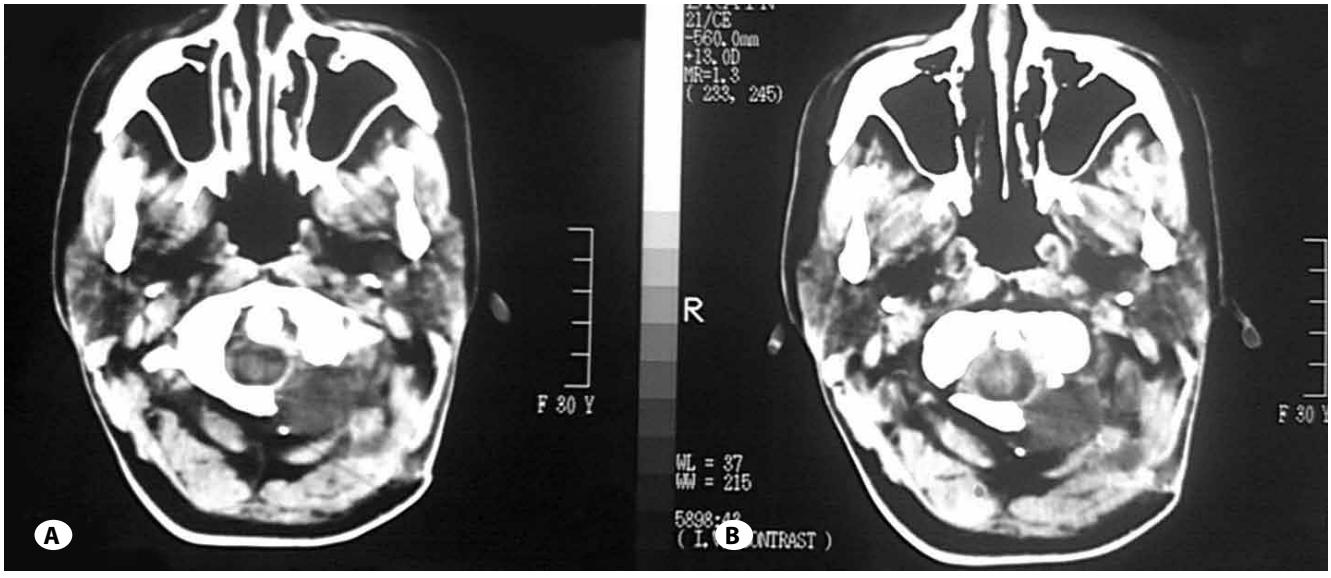

Figure 2: Postoperative CT **A)** and MRI **B)** showing the complete removal of the tumour without the need to remove the occipital condlye. The far lateral route is illustrated by the fluid collection in the wound.

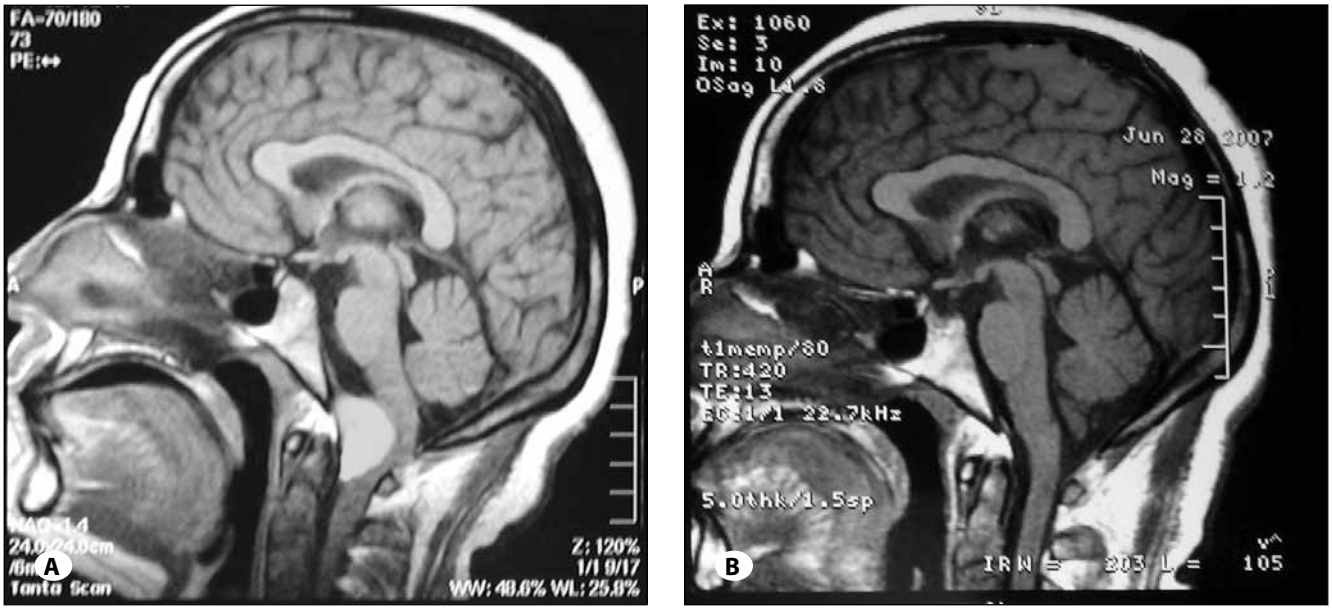

Figure 3: MRI, sagittal cuts, of the craniocervical junction **A)** pre and **B)** postoperative. Showing the complete removal of the tumor.

The two cases of near and subtotal excision belonged to the meningioma group.

All patients improved in the post-operative period. After 3 months all patients achieved a motor power of average grade IV or V. The bulbar symptoms improved in four out of five patients.

Cranial nerve affection was the most common complication after surgery. Four out of the ten patients had immediate lower cranial nerve weakness. Two of these four did not suffer from any cranial nerve affection before surgery, while the other two showed worsening of their existing cranial nerve findings. There was weakness of the hypoglossal nerve in two and weakness of the spinal accessory in three cases. In one case weakness of both the spinal accessory and the hypoglossal nerve coexisted. Of the four patients who had cranial nerve affection, three had meningioma while one had schwannoma. At 6 months of the follow-up, two of the four cases had lower cranial nerve affection. One had hypoglossal while the second had both hypoglossal and spinal accessory nerve affection.

There was a case of cystic swelling of the wound that persisted for 2 weeks post-operatively and did not resolve except when the patient was shunted. There was no incidence of vertebral artery injury in the ten cases.

DISCUSSION

Tumors at the craniovertebral junction are difficult to remove because of their location and complex anatomic relations. Such tumors are surrounded by the vertebral arteries, the lower cranial nerves and the brain stem. Intradural tumors are separated from the retro-pharyngeal space by the bony structures of the clivus and the anterior arch of C1 and the odontoid process whereas extradural tumors tend to be more diffuse, often presenting with extensive bone destruction. The cord is often stretched and deformed (22,26).

The anterior approaches directed through the oral and nasal cavities and paranasal sinuses, although offering a direct route to the clivus, have the disadvantages of the great depth of the surgical field, limited lateral exposure and increased risk of post-operative CSF leakage, especially when dealing with intradural lesions (8,25)

Several modifications of posterolateral approaches were suggested to offer better exposure to such tumors. These modifications were divided into two groups: the far lateral and the condylar approaches (17). The far lateral approach is completed without removal of the occipital condyle but the transcondylar involves removal of some or all of the occipital condyle (19).

The far lateral approach is naturally better than the posterior approach as it minimizes the retraction on the spinal cord and improves the visualization of the anterior aspect of the brain stem. It is a versatile approach to a variety of lesions located ventral to the brain stem and upper cervical cord (13). In the present work this approach offered a good exposure to manage adequately 6 cases of meningioma, 3 schwannomas and a case of hemangiopericytoma.

The occipital condyles occupy the anterior half of the rim of the foramen magnum. Partial or complete removal of the occipital condyle during the lateral approach has received much attention in recent neurosurgical literature. (16) However few recent studies discussing intradural anterior foramen magnum tumors advocate against resection of the condyle (10,11,18,21). Another group of authors (1,3,4,5,6,12,24) advocate partial condyle resection only in some patients.

In the present series of cases, adequate surgical removal of the tumor could be achieved without the need of any partial or complete condyle resection (fig1,2). In some of the presented cases debulking of the tumor created a working space that obviates the need to resect the condyle. This same observation was pointed out by other authors who also believed that large tumors push the neural axis back improving the access to such tumors without the need for condyle excision (18,21).

There is a controversy whether mobilization of vertebral artery is necessary. Many recent publications advocated mobilization of the vertebral artery (19,22,27) in every case. Others found it unnecessary in all cases and believe that the approach should be tailored to the tumor (7,13,14,16). There is usually a concern about injury of the vertebral artery as a result of its dissection and mobilization. Babu 1994 (2) reported 4 cases of vertebral artery injury in 22 cases of extreme lateral transcondylar approach. In all the ten cases presented in this article, the vertebral artery was dissected before removing the posterior arch of the atlas. In nine cases the artery was found easily above the arch of C1. In the tenth case, the vertebral artery arched more posteriorly and was found at a superficial plane to C1 arch. Mobilisation of the vertebral artery was never found necessary and its dissection was never a source of any problem.

The most common complication encountered in the presented cases was cranial nerve weakness. Previous series have demonstrated similar results (1,20,21). One patient developed hypoglossal nerve weakness, two patients showed accessory nerve weakness and the forth suffered from a combined hypoglossal and accessory nerve weakness. A cyst in the surgical wound persisted for 2 weeks and disappeared after a shunt was placed.

In conclusion, the results obtained in this work strongly advocate the use of the far lateral approach to manage tumors of the foramen magnum when situated inside the dura anterior to the neural axis. Neither excision of the condyle nor mobilization of the vertebral artery was done yet the tumor, in most cases, was adequately removed.

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