Evaluation Of Clinical Results In 40 Patients With Basal Skull Fracture

40 Kaide Kırığı Olgusunda Klinik Sonuçların Değerlendirilmesi

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Abstract: Fractures of the basis cranii are usually the result of extension of a vault fracture. The most important complications associated with these fractures are cerebrospinal fluid (CSF) fistula, related infection, and pneumocephalus with fistula. CSF fistula involves the leakage of fluid from the subarachnoid space to the extraarachnoidal space through a defect in the arachnoidea, the dura, or the epithelial tissue. Although this leakage can occur along the cerebrospinal axis, it most often appears clinically as otorrhea and rhinorrhea. Eighty percent of CSF fistulae is caused by trauma, and this complication is seen in 2-5% of closed head trauma cases. With regard to outcome, 85% of rhinorrhea cases and 95% of otorrhea cases improve spontaneously within a week. Meningitis is the most important complication of CSF fistulae. We retrospectively studied 40 basis cranii fracture cases that were treated at our clinic between November 1994 and December 1997. Thirty-four of the patients were male (85%) and six were female (15%), and their ages ranged from 2 to 70 years. The most common cause of the fractures was traffic accident. The patients' Glasgow Coma Scale (GCS) scores ranged from 3 to 15. Of the 40 individuals studied, 19 had otorrhea and 5 had rhinorrhea. Tension pneumocephalus occurred in two cases during the time they were receiving treatment. Posttraumatic meningitis developed in three of our patients, and the mortality rate associated with meningitis was 5% (2/40 patients). Our study also highlighted the importance of other complications that may accompany basis fracture, namely, posttraumatic intracranial infection and tension pneumocephalus.

Key Words: Basal skull fracture, CSF fistula, meningitis, tension pneumocephalus

Özet: Kaide kırıkları, sıklıkla kafa çatısında görülen kırıkların tabana doğru uzanması sonucu oluşur. Kaide kırıklarının en önemli komplikasyonu BOS fistülü ve buna bağlı oluşan enfeksiyonlar ile pnömosefaluslardır. BOS fistülü, BOS'un araknoid, dura veya epitel dokudaki defekte bağlı subaraknoid mesafeden extraaraknoid mesafeye kaçışıdır. Serebrospinal aksın herhangi bir yerinde görülse de en sık otore ve rinore şeklinde ortaya çıkar. BOS fistüllerinin %80'nin nedeni travmalardır ve kapalı kafa travmalarının %2-5'inde BOS fistülü görülür. Rinorelerin %85'i, otorelerin ise %90-95' ilk bir hafta içinde kendiliğinden kesilir. BOS fistülünün en önemli komplikasyonu menenjittir. Kliniğimizde kasım 1994-Aralık 1997 yılları arasında tedavi edilen 40 kaide kırığı olgusu retrospektif olarak değerlendirildi. Hastaların 34'ü (%85) erkek, 6'sı (%15) kadındı. En küçüğü 2 ve en büyüğü ise 70 yaşındaydı. Trafik kazası en sık travmatik nedendi. Glasgow Koma Skalası (GKS) puanları 3-15 arasında değişmekteydi. 19 hastada otoraji ve 5 hastada rinore vardı. İzlem sırasında 2 hastada tansiyon pnömosefalus gelişti. 3 hastada posttravmatik menenjit görüldü. Menenjite bağlı mortalite oranı %5'di. Sonuç olarak bu çalışmada kaide kırığı komplikasyonlarından olan posttravmatik intrakranial enfeksiyon ve tansiyon pnömosefalusun önemi vurgulandı.

Anahtar Sözcükler: Kaide kırığı, BOS fistülü, menenjit, tansiyon pnömosefalus

INTRODUCTION

Basal skull fractures usually result from extension of a vault fracture. Typically, these fractures involve the perinasal sinuses and mastoid air cells (14). Basal skull fractures are divided into two subgroups. Fractures that traverse the petrous pyramid at right angles are called "transverse fractures," and hematotympanum is a common finding in these cases. Longitudinal fractures run parallel to the long axis of the petrous bone and represent 70% to 90% of temporal bone fractures. These fractures often spare the nerves but disrupt the ossicular chain (14). Basal skull fractures can result in injury to cranial nerves and arteries (23). CN VII and/or VIII injuries are associated with temporal bone fracture. Olfactory nerve injury often occurs with anterior fossa basis fractures, and results in anosmia. Injury to CN VI can occur with fractures of the clivus (14). Basal skull fractures are associated with traumatic carotid-cavernous fistulae, traumatic aneurysms of the petrous and cavernous portions of the carotid artery, and carotid artery occlusion (1,18,21,27).

Cerebrospinal fluid (CSF) fistula is the most important complication associated with basal skull fractures. These fistulae are classified in two major groups, as traumatic and nontraumatic (26). CSF fistulae may be detected either in the first week after the trauma (acute), or after months, and even years, posttrauma (delayed). This life-threatening complication was first described by Bidloo and Elder in the 17th century (26). Miller identified nontraumatic rhinorrhea in 1826, and proved that this condition occurs as a result of increased CSF pressure (26). In 1884, Chiari was able to demonstrate a postmortem fistula between the ethmoid sinuses and a pneumatocele of the frontal lobe in a patient who had had meningitis with rhinorrhea (12).

Another important complication, especially of traverse of paranasal mastoid fracture, is pneumocephalus. In addition to head trauma, other causes of pneumocephalus include infection, tumor, congenital cranial defect, shunt placement, and the use of nitrous oxide during anesthesia (3,4,7,20,24,28).

Especially in the past 20 years, our ability to diagnose and treat basal skull fractures and CSF fistulae has improved with the advent of new techniques. The leakage site can now be easily identified using radionuclide cisternography, computed tomography (CT), and magnetic resonance imaging (MRI). CT cisternography with metrizamide is the best diagnostic method (13,19).

CLINICAL MATERIAL AND METHODS

From November 1994 to December 1997, 280 head trauma patients were treated in our department. Forty (15%) of these patients had basal skull fractures, and we retrospectively studied these cases with regard to complications encountered, diagnosis, and treatment.

RESULTS

Of 280 head-injured patients, 40 were diagnosed with basal skull fracture. The ages of these patients ranged from 2 to 70 years, and the mean age was 30.5 years (Table II). Thirty-four patients were male (85%) and six were female (15%). Twelve patients (30%) were children and 28 patients (70%) were adults. The causes of trauma were traffic accident (28 patients), falling (11 patients), and blow to the head (1 patient) (Table II). In each case, neurological condition was evaluated according to the Glasgow Coma Scale (GCS), and patients were categorized in one of three head trauma groups: severe (GCS 3-8), moderate (GCS 9-12), and mild (GCS 13-15). Thirty-five patients (88%) had mild, two patients (5%) had moderate, and three patients (7%) had severe head trauma. Nineteen of the patients had otorrhea and five had rhinorrhea. Craniography and cranial CT were routinely performed on all of the patients. The fracture line was identified in 35% of the cases by craniography, and in 50% of the cases by cranial CT. In addition, cranial CT led to diagnoses of pneumocephalus in 10 patients, brain contusions in 7, brain edema in 2, and acute subdural hematoma in one patient.

Thirty-six (90%) of the patients were treated medically and four (10%) underwent surgery. Medical therapy included the following: 1) elevation of the head, 2) prevention of increases in intracranial pressure (use of cough preventatives, laxatives, sedatives), 3) continued lumbar CSF drainage, 4) drugs to reduce CSF production (dexamethasone, acetazolamide, furosemide), 5) prophylactic antibiotics (cephtriaxon and ornidazole), and 6) use of antiepileptics. In all of the patients who had otorrhea and who received medical treatment, CSF leakage stopped within 1 week. The same was true for all but one patient with rhinorrhea, whose CSF

Table I. Number of cases of head trauma by age group.

Age Group	No. of Cases
0-9	4
10-19	8
20-29	8
30-39	10
40-49	2
50-59	2
60 and over	6

Table II. Causes of head trauma.

Cause of trauma	No. of Cases
Traffic accident	28
Motor Vehicle	24
Bicycle	4
Falling	11
Blow to head	1

Table III. Glasgow Coma Scale scores for the 40 patients.

GCS Score	No. of Cases
Mild (13-15)	35
Moderate (9-12)	2
Severe (3-8)	3

leakage continued for more than 2 weeks.

Four patients underwent surgical treatment. Surgery was indicated when there was rapid deterioration in a patient's level of consciousness and a worsening prognosis. In two patients, cranial CT demonstrated tension pneumocephalus, which required emergency surgical treatment. In one of these patients (GCS 7), the air was released through a drilled burr hole. The other patient underwent craniotomy and duraplasty. A third individual had rhinorrhea that continued for over 2 weeks, and this patient was treated with duraplasty. The fourth patient's cranial CT revealed an acute subdural hematoma, and this required drainage via craniotomy.

Three of the 40 basal skull fracture of patients developed posttraumatic meningitis. One of these individuals had been hospitalized for 3 days at another facility due to trauma, and his level of consciousness deteriorated 2 days after discharge. The patient died 1 hour after admittance to our emergency clinic. There were no signs of pathology on the patient's cranial CT. His CSF was cloudy, and contained 2,400 polymorphonuclear leukocytes per microliter. *Streptococcus pneumoniae* was grown on a CSF culture, which confirmed the diagnosis of posttraumatic meningitis postmortem. Another patient, who had a traumatic corneal laceration, was treated at the ophthalmology clinic. When fever, signs of meningeal irritation, and diminished consciousness developed, this patient was diagnosed with posttraumatic meningitis. Third patient who received prophylactic antibiotics developed meningitis.

The hospitalization period for our patients ranged from 3 to 29 days (mean, 8 days). One patient died due to disseminated pneumocephalus and brain contusions. Another developed subarachnoidal hemorrhage and exophthalmos. In this patient, digital subtraction angiography revealed a carotid-cavernous fistula.

DISCUSSION

Basal skull fractures are clinically associated with CSF fistulae (otorrhea and rhinorrhea), hematotympanum, postauricular ecchymosis (Battle's sign), periorbital ecchymosis (raccoon's eyes), cranial nerve injury, and vessel injury. The reported incidence of basal skull fractures due to cranial trauma ranges from 10-25% (6,10,16). Cranial trauma is considered to cause 80% of all CSF fistulae (20), and this problem is seen in 2-5% of cranial trauma cases (10,12,26). Of 280 head trauma patients admitted to our clinic, 40 had basal skull fractures and 24 of those with basal skull fractures had CSF fistulae. These proportions correspond fairly well with those reported in the literature.

Basal skull fractures and traumatic CSF fistulae are less common in children than in adults (17). This is due to the child's immature growth of the frontal sinuses, the presence of a cartilaginous-type ethmoid bone, and the more elastic basis cranii than adults', all of which result in better absorption of head trauma. We found an expected smaller proportion of pediatric head trauma cases in our study group (30%). Falling and traffic accidents have been identified as the major causes of basal skull fractures and CSF fistulae, and account for 80-90% of these cases (20). Ninety-seven percent of our patients with skull fractures and fistulae had been injured in one of these two ways.

The detection of otorrhea and rhinorrhea is very important with regard to diagnosing CSF fistula and basal skull fracture. Following cranial trauma, fluid leakage from the nose and ear is assumed to be CSF when blood is visualized centrally, surrounded by clear fluid. However, this method of identification is not 100% accurate. The best and most recent method for identifying the origin of the leaked material is the detection of b2 transferrin through immunoelectrophoresis (25). Concerning the diagnosis of CSF fistulae, various techniques have been used to date, including direct craniography, intrathecal injection of different dyes, and pneumoencephalography. The introduction of CT has made it very easy to detect basal skull fractures and associated with CSF fistulae. In particular, thin-slice axial and coronal scanning allows accurate diagnosis and pinpointing of the anatomical location of the fistula and the fracture (2,11).

In 1977, Drayer (13) and Manelfa (19) reported that metrizamide cranial CT-cisternography was the best technique for locating a CSF fistula. Recently, new techniques, including MRI, magnetic resonance-cisternography, digital subtraction cisternography, and positron emission tomography, have been used to this end (15,22,29). Currently, metrizamide cranial CT-cisternography remains the best way to diagnose these fistulae. Craniography and cranial CT were done routinely on all of our patients. Basal skull fractures were identified by craniography in 35% of the cases, and by cranial CT in 50% of the cases. In addition, cranial CT revealed that 10 patients had pneumocephalus, 7 had brain contusions, 2 had brain edema, and 1 had an acute subdural hematoma.

One important complication of basal skull fracture is tension pneumocephalus, a problem that may require immediate surgery (7,20,28). Research has shown that patients with rhinorrhea and otorrhea are at greater risk of developing tension pneumocephalus compared to other head trauma patients (24). In these patients, an increase in nasopharyngeal pressure causes air to enter the cranial cavity through the dural defect and then become trapped. Elevated intracranial pressure may increase the size of the defect and the patient's condition may deteriorate due to the pressure exerted on the brain and the air accumulating inside the cranium. Pneumocephalus was seen in 20% of basal skull fractures. On the other hand 75-80% of pneumocephalus caused by trauma (23).

Cranial CT led to the diagnosis of pneumocephalus in 10 (25%) of our 40 patients with basal skull fractures. Tension pneumocephalus developed in two patients. The treatment for one (GCS 7) involved releasing the air through a burr hole, and for the other involved craniotomy and duraplasty.

Eighty-five percent of patients with rhinorrhea and 95% of those with otorrhea improve spontaneously within 1 week of diagnosis (2,14,17,25). CSF leakage stopped after 1 week in all of our patients who had otorrhea and was treated medically. The same was true for all but one patient with rhinorrhea, whose CSF leakage continued for more than 2 weeks and required surgical treatment.

Meningitis is the most important problem associated with CSF fistulae, and causes high morbidity and mortality, even when antibiotic therapy is used. The incidence of meningitis in patients with trauma-induced CSF fistulae ranges from 3-50% (6,10). *S. pneumoniae* is the most common causal agent in meningitis (14). Eight percent (3/40) of our patients with basal skull fracture developed meningitis. There is controversy regarding the use of prophylactic antibiotics in patients with CSF fistula and basal skull fracture (6,14,17). Some reports have stated that such treatment does not effectively reduce the risk of meningitis in patients with traumatic CSF fistulae (5,14,17,23). Choi et al. (8), who studied 293 cases of traumatic CSF leakage, found the incidence of meningitis was significantly higher in patients who received prophylactic antibiotic therapy than in those who did not receive preventive antibiotic therapy. In contrast, Brodie (7) investigated 324 cases of posttraumatic CSF fistula, and found a lower incidence of meningitis in those who received prophylactic antibiotic therapy than in those who did not use preventive antibiotics. Of all our patients with basal skull fractures and CSF fistulae who were given antibiotic therapy, only one developed meningitis. On the other hand, two of the patients who were not given prophylactic antibiotics developed this infection. Based on these findings, we advise the use of preventive antibiotic treatment in patients with basal skull fracture and CSF fistula.

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