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ANTERIOR SKULL BASE FRACTURES AND THEIR MANAGEMENT- AN EXPERIENCE OF 89 CASES

Neurosurgery

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ABSTRACT

Introduction: Anterior skull base fractures are the most common skull base fractures. The risk of CSF leak and meningitis complicates its management. Majority of patient can be managed conservatively. Persistent CSF leaks require surgical intervention. We here describe our cases series with review of literature.

Material and Methods: This is a retrospective case study of 89 cases of anterior skull base fractures between Jan 2015 to June 2017. All data were recorded from case files and demographic, clinical and final outcome studied.

Results: Out of 89 cases, 46 had CSF leaks. Of all cases presented with CSF leaks, 30 were stopped with conservative management. Only 16 cases required operative intervention. One patient developed meningitis.

Conclusion: Majority of cases of post traumatic skull base fractures can be managed conservatively. Only few patients who has persistent CSF leak beyond 7 days requires surgical intervention.

KEYWORDS:

Skull base, Skull Fractures, CSF rhinorrhoea, anterior cranial fossa fractures, Pneumocephalus

INTRODUCTION:

Skull fractures are common after high impact road traffic accidents. In addition to the calvarial fractures, skull base fractures pose difficult problems due to associated CSF leak and risk of developing meningitis. As nasal cavity and para-nasal sinuses are separated from cranial cavity by a thin plate formed of frontal, ethmoid and sphenoid bones, they are particularly more vulnerable to fracture. In most of these cases impact of force is on face with transmission of force through skull base. It is not uncommon to find associated facial soft tissue and bony injuries along with periorbital ecchymosis, known as Raccoon's eye[14]. Dural tear is not found in many cases, even though dura is closely adhered to the skull base. In cases with CSF leak through dural defect, careful evaluation is mandatory. A good understanding of the management strategy helps deal with such cases successfully.

MATERIAL AND METHODS:

This is a retrospective study of 89 cases of traumatic head injury presented in emergency department of Pt. JLNM Medical College Raipur. Study period was from Jan 2015 to June 2017 (30 months). Data was recorded from case files and demographic, clinical, radiological and surgical observations were recorded. The inclusion criteria were - History of traumatic head injury, Radiological evidence of anterior skull base fractures with or without fracture of posterior wall of frontal sinus, No other significant intracranial injury requiring operative intervention, No other significant systemic injury. Patient with fractures involving the anterior wall of frontal sinus only were excluded and patients with both wall of frontal sinus without anterior skull base involvement were also excluded.

All patients were managed conservatively initially and decisions were made according to their clinical condition. All patients received prophylactic antibiotics in form of cephalosporins. All patients nursed flat with high flow oxygen and prophylactic anti epileptic drugs were given as per trauma protocol. When decision was made for surgical management, all patients underwent bifrontal craniotomy and solely extradural repair of dural defects with on-lay vascularised peri-cranial fascia graft was done.

RESULTS:

A total of 89 cases were found on retrospective analysis of all traumatic head injury cases meeting the inclusion criteria. All patients had radiological evidence of anterior skull base fractures along with pneumocephalus, eight patients had pneumoventricle along with pneumocephalus. All patients underwent high resolution CT scan to localise defect. Mean age of presentation was 38.04 years (range 17-65 years), there were 73 males (82.02%) and 16 female (17.97%) patients. CSF leak was clinically evident in 46 (51.68%) cases. All cases were managed conservatively in initial period with flat bed nursing, high flow oxygen, prophylactic antibiotics, prophylactic anti epileptic drugs, acetazolamide and furosemide. Eight cases (8.98%) had pneumoventricle along with pneumocephalus. All of these cases failed on conservative management and required surgery later on. CSF leak stopped in 30 out of 46 cases (65.21%) with conservative management. In 19 (21.34 % of all cases, 41.30 % of CSF leaks) cases CSF leak completely stopped in 48 hours while in eleven case (12.35 % of all cases, 23.91 % of CSF leaks) CSF leak decreased in first 48 hours but completely stopped in mean duration of 5.47 days. In 16 patients (34.78% cases of CSF leak and 17.97% of total study population) who had persistent CSF leak, beyond seven days of conservative management were consider for surgical intervention in form of bifrontal craniotomy and total extradural repair of dural tear with onlay vascularised pericranial fascia graft. Six out of 16 surgical patients (37.5%) who had bony defect greater than 1 cm required split calvarial graft for bone defect and overlay tensor fascia lata graft with fat globules. Fibrin glue was used in difficult reconstruction. There were no deaths in the study cohort. The results have been summarised in table below.

RESULTS	
Total number of cases	89
Mean age	38.04 years
Age Range	17-65 years
Male/Female ratio	73:16
No. Of CSF leaks	46/89 (51.68%)
Management Outcome	
1. Resolution of CSF leaks	30/46 (65.21%)
a. In 48 hours	19/46 (41.30%)
b. In 2-7 days (Mean 5.47 days)	11/46 (23.91)
2. Surgical intervention	16/46 (34.78%)

DISCUSSION:

Head injuries are the most common neurosurgical emergencies worldwide. In current era, use of motor vehicles leading to road traffic accidents is the main causative factor. Brain is well protected by bony

skull, but high impact of trauma lead to skull fractures and brain injury. History of skull base fractures and CSF rhinorrhoea dates back to mid 17th century when Bidloo first described it[1]. But radiological correlation could only be established in early 19th century when intracranial aerocele was demonstrated by Luckett in 1913[2]. Thereafter multiple classification of CSF rhinorrhoea has been proposed by various authors. The simplest to use is Traumatic versus spontaneous CSF leak. Most of the surgical techniques have been adopted from Dandy's demonstration of intradural repair with fascia lata[3,4] or Cairn's technique of extradural repair with fascia lata[5]. After evolution of endoscopic skull base techniques, most of the cases are being managed endoscopicaly using vascularised pedicle grafts with excellent results[6,7,8]. Skull base is divided into anterior, middle and posterior cranial fossa. Anterior skull base is formed medially by papery thin ethmoid bone-cribriform plate and crista galli; and laterally by thin orbital plate of frontal bone anteriorly and orbital plate of lesser wing of sphenoid postero-lateraly. Middle cranial and posterior cranial base are formed by relatively stout bones. In cases of direct impact over face or transmission of force through skull base, fracture of the relatively thin anterior skull base is more common. Dural tear along the fracture segments subjects the patient to CSF leak and future meningitis. CSF leaks are 5-6 times more frequent in anterior skull base fractures than middle and posterior skull base fractures[6].

Incidence of CSF leaks varies between studies and depends upon patient population, impact of injury and complexity of fractures. In one study it was 10-30% of all skull base fractures[9,10]. In our study incidence was 51.68% in anterior skull base fractures. In study by Scholsem M[7] the incidence was 39%. In present series we have higher risk of CSF leak (51.68%) in all anterior skull base fractures. For diagnosing the leaking fluid as CSF, we have relied on target sign and reservoir sign. Fluid glucose level and beta 2 transferrin were not studied in our cohort. This may be the reason for higher incidence of CSF leak in this study. Overall 15-50% of patients developed meningitis as a sequel with nearly 30% neurological complication rate[11]. Some authors have reported an overall 30.6% risk of meningitis before surgical repair and a risk of 1.3% per day in the first 2 weeks after injury, 7.4% per week in the 1st month after injury, and a cumulative risk of 85% at the 10-year follow-up[11]. We were fortunate to not have fatal meningitis in any of the cases.

Various authors have attempted to classify these fractures. Most commonly used is Type A- Fracture of anterior wall of frontal sinus only, Type B- Fracture of posterior wall of sinus only, Type C- isolated basi-frontal fracture[12]. This classification has inherent problem in classifying complex fracture involving more than one component. Indication of treatment of Type A fractures are solely cosmetic but indications for treatment of Type B, C and complex fractures are debatable and pose difficulty in making decision. In this study we have excluded Type A fractures and only type C and complex fractures had been studied to make individual decisions simple. Sakas et al[10] has classified these fractures in four types based on anatomic location Type I - Linear fracture through the cribriform plate without involvement of the ethmoid or frontal sinuses; Type II – Fronto-ethmoidal, fracture that extends through the medial portion of the anterior cranial fossa floor where it directly involves the ethmoid sinuses and/or walls of the medial frontal sinus; Type III - Lateral frontal, fracture that extends through the lateral frontal sinus (supero-medial wall of the orbit) and may involve the superior or inferior walls of the lateral frontal sinus; and Type IV, complex, any combination of the prior types. CSF leaks are more common in midline fractures as in type I and II as compared to laterally placed fractures(60% in Type I and 43% Type II). Authors concluded that anterior skull base defect larger than 1 cm, midline fractures; persistent CSF leak after 8 days has high chances of meningitis[10]. Same has been demonstrated by Madhusudan et al[13] in their study. At the region of cribriform plate dura is densely adhered at the lateral margin amenable to tear and in midline there is only thin arachnoid layer which got easily torn during motion. There is more CSF in the gutter at either side of midline increasing the chance of CSF leak.

Timing of repair of CSF fistulas is debatable as majority of cases (60-85%) CSF leaks stops spontaneously after conservative management [15,16]. In our series on 17.97 % patients only required surgery. Conservative management was successful in 82.03% cases. Of all patient presented having CSF leak only 34.78% cases required surgery, while 65.21% patients were successfully treated with conservative means. We have adopted a conservative period of seven days under prophylactic antibiotic cover for decision regarding operative intervention. We were fortunate that there was no clinically significant meningitis in conservative group. The incidence of meningitis in CSF leak is higher in first few weeks. The role of prophylactic antibiotics in this scenario is a controversial issue and there are reports in favour and against it. In most of neurosurgical practice prophylactic antibiotics are in use and CSF leak persisting more than one week has higher chance of developing meningitis[17]. We have adopted this strategy and any CSF leak persisting more than 7 days we strongly recommend surgery.

In present era High resolution CT scans has replaced plain radiographs for diagnosis of CSF rhinorrhoea. It has sensitivity and accuracy nearly 87%[18]. In our cohort all patient underwent high resolution CT scan in axial, coronal and saggital plane. Axial films are more helpful in evaluation of frontal sinus wall fractures while coronal films are more helpful in anatomical localisation in midline. CT cisternography has emerged as 95 % sensitive and specific diagnostic tool for localisation of fistula site but has inherent risk of developing meningitis and problems related to contrast administration[19]. If leak is not active CT cisternography is more useful than high resolution CT. We required CT cisternography in only three cases. MR cisternography is an alternative imaging modality with sensitivity close to 85-94% and avoids the risk of meningitis and contrast administration[19]. It is heavily weighted T2 images and easy to interpret. We required MR cisternography in eight cases.

Surgery has been traditionally reserved in cases with persistent CSF leak. Some authors prefer early surgery to reduce the risk of meningitis[11]. Early repair reduces the chance of spontaneous healing, which occurs in large number of cases. Both transcranial and extracranial procedures has been described in literature[2,3,4,6,7,11]. With advent of endoscopic skull base surgery, the current trend is for transnasal repair using vascularised pedicle grafts[8]. Fibrin glue has been great boon in all type of complex repairs. Early surgery is advocated in cases of profuse CSF leak, large skull base defects, pneumoventricle and in cases requiring surgical intervention for other associated injuries[17]. In transcranial repairs, bifrontal or unifrontal craniotomy, extradural, intradural or combined repairs are frequently done. After dural closure various patches can be used as pericranial fascia, temporal fascia, autologus tensor fascia lata and fat globules. Split thickness calvarial grafts can be used for bone defects[12,13].

Another controversial issue is the use of lumber drain in these cases. There has not been any guideline for their use or no use. Their use is primarily personnel or institutional based practice. Some authors had reported the increased incidence of meningitis with use of lumber drains[20]. In our cohort we have not used lumber drain in any patient.

CONCLUSIONS:

There are many controversies in the optimal management of anterior skull base fractures. It should be suspected in a patient who had high impact facial trauma and with clear discharge from nose. Simple bedside tests are helpful in making diagnosis of CSF rhinorrhoea. High resolution CT scan is useful modality in radiological diagnosis and localisation. Only specific cases require higher investigation in form of CT or MR cisternography. Optimal timing of repair is still controversial. Majority of CSF leaks stops with conservative management. CSF leaks persisting more than 7 days requires, thorough investigation and optimal surgical intervention.

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