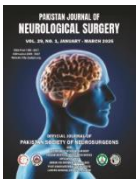

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Original Research

Frequency of CSF Rhinorrhea in Patients with Skull Base Fractures

Kamran Ullah[1], Muhammad Irfan Javed[2]
[1]Departement of Neurosurgery, Muhammad College of Medicine, Peshawar
[2]Departement of Neurosurgery, Hayatabad Medical Complex, Peshawar - Pakistan

ABSTRACT

Background: To determine the frequency of CSF rhinorrhea in patients presenting with skull base fractures.

Material and Methods: This was a descriptive cross-sectional study at the Department of Neurosurgery, PGMI/Hayatabad Medical Complex Peshawar for six months in which patients were included through nonprobability convenience sampling. Included were patients who had radiologically confirmed skull base fractures at presentation. The data on clinical presentations, demographics, and the existence of CSF rhinorrhoea was collected and analyzed through SPSS.

Results: A total of 87 patients were included in the study. The mean age was 41.56±1.35 years. The majority of the patients were males 50(57.5%) as compared to females 37(42.5%). Grade of Head Injury determined showed that patients in the mild category were 30(34.5%), moderate was 39(44.8%) while those in the severe category were 18(20.7%) Prevalence of CSF Rhinorrhea among patients was 56(64.4%).

Conclusion: The results of our study concluded that CSF rhinorrhoea is a prevalent consequence of skull base fractures. Meningitis and other potentially fatal consequences can be avoided with early detection and prompt treatment. Those persisting for more than seven to ten days have a high risk of developing meningitis and are more likely to need surgical intervention.

Keywords: CSF rhinorrhea, frequency, prevalence, skull base fractures.

Corresponding Author: Muhammad Irfan Javed
Department of Neurosurgery
Hayatabad Medical Complex, Peshawar
Email: mijdr1210@gmail.com

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INTRODUCTION

Any fracture affecting the floor of the anterior, middle, or posterior cranial fossa brought on by a direct or indirect traumatic force is referred to as a traumatic skull base fracture. Studies have reported the prevalence of skull base fractures between 3.5-45.4 percent of all skull fractures due to head injuries.[1] The world's greatest cause of death for people under 45 is trauma and head injuries account for a major contributor to the high mortality. The most common mechanism of injury

includes high-speed motor vehicle accidents followed by falls from heights, pedestrian injuries, assault, and penetrating injuries.[2] Skull base fractures can present with cerebrospinal (CSF) rhinorrhea, CSF otorrhea, battle sign (retro auricular mastoid ecchymosis), raccoon eyes (periorbital ecchymosis), cranial nerve injuries, and hemotympanum. Studies have reported the frequency of CSF leaks after the base of skull fractures between 10-30 percent. CSF rhinorrhea occurs because of the establishment of communication between the subarachnoid space and the sinonasal tract leading to leakage of CSF through the nose as a result of trauma.[3] The most common site of fracture associated with CSF rhinorrhea is the anterior cranial fossa. In the majority of cases, CSF rhinorrhea occurs within 48 hours of injury, however, it may occur even 1 week after trauma. Most of the cases of CSF rhinorrhea are managed conservatively while in cases of persistent leak, herniation of brain matter, penetrating trauma, large intracranial aerocele, and larger defects which have a low probability of repair; surgery is opted for repair of dura instead of conservative management [4]

Cerebrospinal fluid (CSF) rhinorrhea is an uncommon but potentially fatal illness that can cause a patient to suffer from severe morbidity and death. The fundamental cause of the CSF discharge into the nasal cavity is a disruption of the barriers separating the anterior and middle cerebral fossae from the sinonasal cavity. Numerous viral complications that cause substantial morbidity and perhaps catastrophic long-term damage for the patient can arise from the ensuing connection with the central nervous system (CNS).[5] A traumatic or surgical lesion in the skull or spine, the external auditory canal (otorrhea), or the nose (rhinorrhea) can all cause a leak of cerebrospinal fluid (CSF).[6] Meningeal dural and arachnoid laceration with fistula formation is the cause of the fluid leak. The most frequent cause is blunt trauma.[7] In adults, traumatic CSF leaks have been seen in 10–30% of skull base fractures. Over 50% of these appear within 48 hours.[8] Ninety percent of CSF leaks are caused by penetrating and closed-head trauma. There are two types of CSF rhinorrhea after a traumatic injury: immediate (within 48 hours) and delayed. Most individuals who have a CSF leak as a result of unintentional trauma (such as a car accident) show up right away. Ninety-five percent of individuals who have a delayed CSF leak show up within three months of the injury.[9]

The purpose of this study was to ascertain how common CSF rhinorrhea is in patients who had skull base fractures.

MATERIALS AND METHODS

Study Design, Setting, and Duration

The PGMI/Hayatabad Medical Complex's Department of Neurosurgery in Peshawar was the site of this descriptive cross-sectional study. After the synopsis was approved, The study was carried out between February 2020 and July 2020, a span of six months.

Patient Selection Criteria

Non-probability convenience sampling was used to choose the participants. Patients of either sex who were between the ages of 15 and 60, ASA I, II, or III, and who presented with skull base fractures following the operational definition met the inclusion criteria. To be eligible, patients had to have a body mass index (BMI) of 19 to 30 kg/m2, which was determined by dividing their height in meters squared by their weight in kilograms. Measurements were taken with an inch of tape and a weight machine. Patients with ASA IV or V classifications, a history of spontaneous CSF rhinorrhoea, prior skull base surgery, or space-occupying brain lesions found by CT scans were among the exclusion criteria. Furthermore, individuals who were brought in dead or with facial degloving injuries were also excluded.

Data Collection Procedure

The study included 87 patients who were diagnosed with skull base fractures and presented to the Department of Neurosurgery, PGMI/ Hayatabad Medical Complex, via the emergency room. After receiving permission from the CPSP Research Evaluation Unit and the hospital's ethical review committee, enrolment was completed. Written consents were taken from all participants or their attendants on a form.

The mechanism of damage was recorded, and a thorough history was obtained from the attendants for every patient. A comprehensive physical examination was carried out with a particular focus on neurological assessment, and primary and secondary surveys were conducted in compliance with the guidelines provided by Advanced Trauma Life Support (ATLS). Using predetermined criteria, the injuries were categorized as mild, moderate, or severe.

According to the operational definition, patients who were identified with CSF rhinorrhoea were further evaluated using brain CT scans that included bone window views and three-dimensional reconstructions. The study only included participants who had confirmed skull base fractures, and the precise locations of the fractures were recorded.

A pre-made questionnaire was used to collect data from each subject. To guarantee their comfort throughout the study duration, participants received considerate and respectful treatment. To reduce bias and confounding variables, the exclusion criteria were rigorously followed. To ensure treatment consistency, the same neurosurgical team carried out each procedure.

Data Analysis

SPSS Version 23 was used to analyze the gathered data. The means and standard deviations of quantitative variables, including age, BMI, and Glasgow Coma Scale (GCS) scores, were used. The following qualitative factors were recorded as frequencies and percentages: gender, location of skull base fractures, method of injury, grade of injury, presence of CSF rhinorrhoea, and ASA classification.

Variables like age, BMI, gender, ASA class, mechanism of injury, grade of injury, and fracture location were controlled through stratification to address potential effect modifiers. For post-stratification comparisons, the Chi-square test was employed, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

Study Setting, Demographics, and Gender Distribution

Our study included 87 patients whose mean age came to 40.1 years (±12.8). Nine patients (10.3%) were between the ages of 15 and 20; seventeen patients (19.5%) were between the ages of 21 and 30; six patients (6.9%) were between the ages of 31 and 40; thirty-three patients (37.0%) were between the ages of 41 and 50; and twenty-two patients (25.3%) were between the ages of 51 and 60. According to the gender breakdown, men made up the majority (57.5%, or 50 patients), while women made up 42.5%, or 37 patients.

Table 1: *Gender distribution and age groups.*

Variable	Sub-Category	Frequency/Percentage
Age Group (Years)	15-20	9 (10.3%)
	21-30	17 (19%)
	31-40	6 (7%)
	41-50	33 (38%)
	51-60	22 (25%)
Gender	Male	50 (57%)
	Female	37 (43%)

Body Mass Index (BMI) Distribution

Regarding body mass index (BMI), 9 patients (10.3%) were underweight, 28 (32.2%) had a normal weight, 18 (20.7%) were overweight, and 32 (36.8%) were obese.

Glasgow Coma Scale (GCS) at Presentation

The Glasgow Coma Scale (GCS) at presentation revealed that 24 patients (27.6%) had mild GCS scores, 45 (51.7%) had moderate scores, and 18 (20.7%) had severe scores.

Table 2: *Glasgow Coma Scale (GCS) Score.*

GCS Score		Frequency/Percentage
Mild	(13-15)	24 (28%)
Moderate	(9-12)	45 (52%)
Severe	(3-8)	18 (21%)

Prevalence of CSF Rhinorrhoea and Grade of Head Injury

CSF rhinorrhoea was observed in 56 patients (64.4%) while thirty patients (34.5%) had mild head injuries, thirty-nine patients (44.8%) had moderate head injuries, and eighteen patients (20.7%) had severe brain injuries. The mechanism of injury was most commonly due to road traffic accidents (39 patients, 44.8%), followed by falls from height (33 patients, 37.9%), and other causes (15 patients, 17.2%).

Anatomical Location of Fractures

The analysis found fractures in three areas of the skull: 33.3% in the anterior cranial fossa, 44.8% in the middle cranial fossa, and 21.8% in the posterior cranial fossa.

Table 3: *Prevalence of CSF Rhinorrhoea.*

CSF Rhinorrhoea	Frequency/Percentage
Present	56 (64%)
Absent	31 (36%)

Table 4: *Anatomical location of fractures.*

Fracture Location	Frequency/Percentage
Anterior Cranial Fossa	29 (33%)
Middle Cranial Fossa	39 (45%)
Posterior Cranial Fossa	19 (22%)

Association of Different Variables with Prevalence of CSF Rhinorrhoea

Stratification of CSF rhinorrhoea by age showed the highest prevalence in the 41–50-year age group, where 25 patients (43.9%) had CSF rhinorrhoea. Gender stratification revealed that 87.7% of males experienced CSF rhinorrhoea compared to 12.3% of females. BMI stratification indicated that 77.8% of underweight patients experienced CSF rhinorrhoea. Patients with moderate head injuries had the highest prevalence of CSF rhinorrhoea (30 patients, 52.6%).

Table 5: *Association of CSF Rhinorrhoea prevalence with different variables.*

Variable	Category	CSF Rhinorrhea Cases (n)	Association (Chi-Square Test)
Age	15-20	9	$\chi^2 = 58.462$, df = 4, p = 0.000 (Significant)
	21-30	17	
	31-40	6	
	41-50	24	
	51-60	0	
Gender	Male	50	$\chi^2 = 65.082$, df = 1, p = 0.000 (Significant)
	Female	6	
Head Injury Severity	Mild (GCS 13–15)	30	$\chi^2 = 49.213$, df = 2, p = 0.000 (Significant)
	Moderate (GCS 9–12)	26	
	Severe (GCS ≤ 8)	0	

Our analysis demonstrated age ($p<0.001$), gender ($p<0.001$), and head injury severity ($p<0.001$) create noticeable links with CSF rhinorrhoea. These findings underscore the importance of understanding demographic and clinical factors associated with CSF rhinorrhoea in managing patients with skull base fractures.

DISCUSSION

A strong blow to the head leads to the base of skull fractures.[10] Research shows BSF develops in between 3.5% and 45.4% of all HI patients according to separate medical studies. The majority of published data comes from Western and industrialized nations, where the frequency of HI is lower than in emerging and undeveloped nations.[11-14] About 2% of all head injuries and 12% to 30% of all BSF cases result in traumatic CSF leaking.[15-17] In our study, the incidence of BSF was 3.85%, while 22.16% of patients with BSF had CSF leaks. The overall rate of CSF leakage through the base of the skull in all HI patients was found to be 0.08%.

Our study's male prevalence (81.44%) can be attributed to the fact that men are more likely than women to participate in outdoor activities in our society, which makes them more vulnerable to trauma. The majority of victims (29.9%) were between the ages of 18 and 30, which may have been brought on by inexperience, a propensity for taking chances and drinking. Our study's comparatively low BSF prevalence (3.85%) is similar to that of wealthy nations. Better police enforcement of traffic rules plus driver and rider adherence to safety habits such as belts and helmets led to this improvement. Several studies show that the middle cranial fossa (MCF) is the region of the skull most often affected by BSF. The reason is thought to be the MCF's thin bones that have multiple openings.[11,13,18] ACF is the most frequent site of BSF, according to a small number of other reports.[12,5] Our examination found that ACF fractures appeared fifty percent of the time with multiple fractures present at 38.14% and MCF fractures representing 10.82%. The thick occipital bone and propensity to fall forward after RTA are probably the main causes of the uncommon posterior cranial fossa fractures. ACF and MCF fractures occur frequently because of this same underlying factor.

To identify BSF, several researchers have recommended multislice HRCT together with other cutting-edge imaging techniques.[19-23] Several experts have shown that recognizing initial physical findings is key to detecting BSF.24, 25, 26) Using Flores et al's, list, otorrhagia (blood from the nose) and periorbital ecchymosis across both eyes correctly found 70% of brain injuries. On the other hand, everyone with battle's sign or unilateral periorbital ecchymosis had a brain injury, their research demonstrated.[25] Both Goh et al and our study found strong connections between BSF symptoms seen on the skin and CT scan findings.[26] Furthermore, among our patient group, Battle's sign was seen in 29.9% (136) of cases, subconjunctival hemorrhage in 37.63% (73), and raccoon eyes in 63.92% (124) Rhinorrhea developed in 34 patients during this time (22.16% total cases), while otorrhea formed in nine patients representing 20.93% of those affected. Raccoon eyes and rhinorrhea are more common than other indications in our analysis, which may be because the majority of BSF locations are in ACF. The medical community widely recognizes that ear discharge after a temporal bone fracture results from tympanic membrane damage yet CSF leaking from the nose may occur through the Eustachian tube.[27]

As a high-volume facility, we first use a CT brain plain with a bone window to screen all patients suspected of having HI following a basic clinical assessment. If there is any clinical or radiological suspicion of BSF in the CT brain, HRCT (1 mm slices) with axial, coronal, and sagittal reconstructions is performed. Since HRCT is more expensive and time-consuming than the CT brain plain, this saves us a great deal of time and resources when setting up an emergency. Patients with BSF who have been clinically or radiologically confirmed are admitted, and we constantly monitor them for the emergence of CSF leaks or other BSF symptoms. If there is a C SF leak, a lumbar puncture is done; CSF is cultured and evaluated for Gram-stained preparations, standard protein content, glucose levels, and cell assessment. Thus, only five of our 12 patients,

41.67%, with meningitis with positive CSF culture; 11.63% of all patients with the CSF leak; and 2. 58% of the patients with BSF. Of these patients, Klebsiella species was the most frequently isolated organism accounting for 60% (3/5). The early authors recommended that patients with BSF should always use preventive antibiotics frequently.[28- 30] Prophylactic antibiotics in patients with BSF as well as those with or without CSF leakage are found not effective in RCTs namely; Ratilal et al, surveyed five RCTs including 208 participant and 17 non-RCTs comparing the antibiotic prophylaxis with placebo or no intervention.[31] The overall incidence of meningitis in our series for BSF was 2.85% and this corroborates the recent suggestion by many authors that there is no rationale for administering antibiotics to patients with BSF.[32,33]

In our BSF series, the overall mortality rate was 6.7%. BSF patients with severe HI had a significantly higher mortality rate (13.64%). The increased fatality rates in these patients were explained by related severe intracranial injuries. Eleven patients died from various HI-related causes other than meningitis, as a cause of meningitis one patient each died from mild and moderate HI. Posttraumatic CSF meningitis mortality rates vary greatly among studies, ranging from 0% to 65%.[5] Our preoperative deaths were 16.67 (2/12 patients) of this series which is higher than the overall 6.7% mortality resulting from all types of BSF. Meningitis was the only cause of death among mild HI patients. This suggests that if meningitis is identified and treated promptly, it has been shown here that mortality in mild to moderate HI with BSF and CSF leak can be prevented. More research is needed to shed more information on the topic of head trauma and BSF, particularly in emerging nations, given the shifting patterns in HI and safety precautions. This work could be used as a pilot for larger-scale research.

CONCLUSION

The results of our study concluded that CSF rhinorrhoea is a prevalent consequence of skull base fractures. Meningitis and other potentially fatal consequences can be avoided with early detection and prompt treatment. Those who continue for more than seven to ten days are at a higher risk of meningitis and are more likely to require surgery.

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Additional Information

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AUTHORS CONTRIBUTIONS

Author's Full Name	Intellectual Contribution to Paper in Terms of:
Kamran Ullah & Muhammad Irfan Javed	Paper writing, study design and methodology.
Kamran Ullah & Muhammad Irfan Javed	Data collection, data analysis, interpretation of results.
Kamran Ullah & Muhammad Irfan Javed	Literature review and referencing.