ORIGINAL ARTICLE

Autopsy and Histopathologic Analysis of Traumatic Brain Stem Injury

AISHA RASHEED SHAIKH[1], SONO MAL[2], EJAZ AHMED AWAN[3], *ISHRAT BIBI[4], FARAH WASEEM[5], ABDUL SAMAD[6]*
[1,4]Lecturers, Department of Forensic Medicine & Toxicology, Liaquat University of Medical & Health Sciences, Jamshoro
[2]Associate Professor,
[5]Senior Lecturer, Department of Forensic Medicine & Toxicology, Sindh Medical College, Jinnah Sindh Medical University, Karachi
[3]Associate Professor,
[6]Assistant Professor of Forensic Medicine & Toxicology, Peoples University of Medical & Health Sciences for Women, Nawabshah, Shaheed Benazirabad
Correspondence to Dr. Ejaz Ahmed Awan, Email: forensicawan@outlook.com Cell 0300-3219531, 0335-9900369

ABTRACT

Aim: To determine the frequency, pattern and location of brainstem injuries with histopathologic analysis during postmortem examinations.
Study Design: Retrospective study
Place and Duration of Study: Department of Forensic Medicine& Toxicology and Department of Pathology, Peoples University of Medical & Health Sciences for Women, Shaheed Benazirabad, Sindh from 1st January 2014 to 31st December 2018.
Methodology: Eighty three cases with head injury were reported, of them 48 had brain stem hemorrhage. Brain autopsy was performed, and findings are reported.
Results: The mean age of patients was 57.12±6.24 years. Mid brain hemorrhage was found in 20(41.6%) patients while pontine hemorrhage was found in 10(20.8%) patients. Eight (16.6%) patients had hemorrhage at medulla, 7(14.5%) patients had hemorrhage at the ponto-medullary junction, while 3(6.2%) patients had hemorrhage at cervico-medullary junction. The most common mode of injury was road traffic accidents (n=23) followed by assault (n=14), blow to the neck (n=9) and fall (n=2).
Conclusion: most common site for hemorrhage in brainstem was midbrain followed by pons and medulla. Traumatic brainstem injuries are often associated with lesions at other sites of brain and poor prognosis. The most common mode of injury in our study was road traffic accidents.
Keywords: Brainstem injury, Trauma, Brainstem hemorrhage

INTRODUCTION

In 1812, Cheyne et al[1] first reported the incidence of brainstem hemorrhage on his study on patients having lethargy and coma. The prognosis of brainstem hemorrhage is very poor. It has an estimated mortality rate of 83% and half of the surviving patients remain in a persistent vegetative state[2]. The incidence of traumatic brain stem injury varies between 8.8% to 52%[3,4].

Traumatic brainstem injury can be divided into two categories, primary and secondary. Primary brain injury is defined as the direct mechanical distortion of the brain stem. Secondary brain injury is a result of diffuse cerebral edema, hypoxia to brain tissues and vasospasm of brain vessels. It is also seen secondary to brain stem herniation in many cases,[5,6] Many studies have shown that traumatic brain injury co-exists with acute epidural hematoma, subdural hematoma and brain contusions[4,7].

It has been shown in studies that injuries impacting the neck frequently result in brainstem lesions.[8] The most frequent site of traumatic brainstem lesions is dorsal side of midbrain.[9] Brainstem is very prone to injury in case of head trauma as all structures in the cranium converge to exit at the central point. It is also seen that injuries which lead to contusions at the temporal and frontal lobe also lead to injury at brainstem[10].

Received on 17-07-2019
Accepted on 03-01-2020

MATERIALS AND METHODS

This study was conducted at Department of Forensic Medicine& Toxicology and Department of Pathology, Peoples University of Medical & Health Sciences for Women, Shaheed Benazirabad, Sindh from 1st January 2014 to 31st December 2018.Patients with traumatic head injury between ages 25-75 years were included and patients with previous head injury were excluded. A total of 83 cases with head injury were reported during the study duration, of them 48 had brain stem hemorrhage. The patients underwent initial investigations such as CT scan, biochemical and hematologic investigations. Clinical examination was performed and patients were appropriately managed. Post-mortem examination was carried out within 48 hours of death. Informed consent was taken from family for autopsy and inclusion in study. Complete autopsical examination was performed with recording of site of skull fracture, presence of absence of epidural, subdural and subarachnoid hematoma, cerebral contusions, cerebral lacerations, cerebral edema, parenchymal herniation and hemorrhage. Histologic sections were analyzed microscopically after fixing brain in 0.1% formalin solution. The data was entered and analyzed through SPSS-20.

RESULTS

The mean age of patients was 57.12±6.24 years. The minimum age was 47 years and maximum age was 68 years. Of 48 patients, 32 were males and 16 were females (Fig. 1). The most common mode of injury was road traffic

accidents (n=23) followed by assault (n=14), blow to the neck (n=9) and fall (n=2). Skull fracture was present in 18(37.5%) patients. Mid brain hemorrhage was found in 20 (41.6%) patients while pontine hemorrhage was found in 10 (20.8%) patients. Eight (16.6%) patients had hemorrhage at medulla, 7(14.5%) patients had hemorrhage at the ponto-medullary junction, while 3(6.2%) patients had hemorrhage at cervico-medullary junction (Fig. 2). Pure brainstem lesions were found in three patients. Other patients had cerebral contusions lacerations and deep brain structure damage. Two patients had subarachnoid hemorrhage while three patients had inter-parenchymal hemorrhage.

Fig. 1: Gender distribution in our study

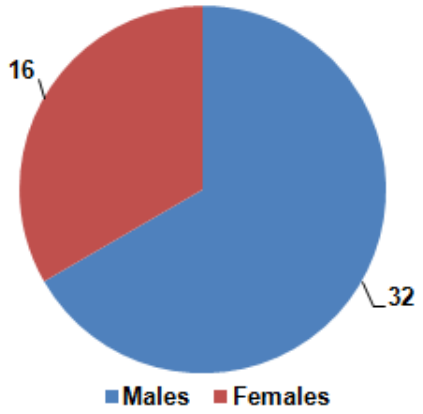
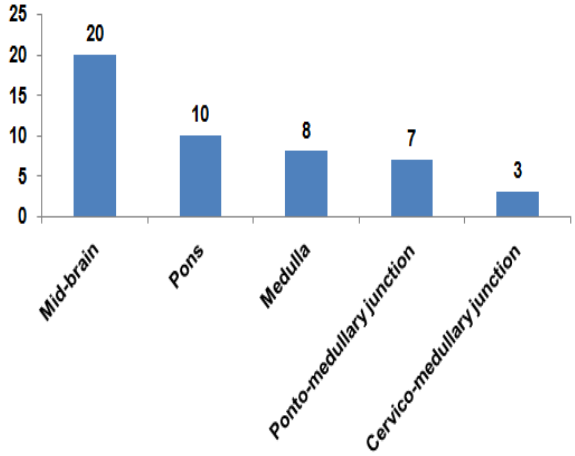


Fig. 2: Brainstem hemorrhages among our study population



DISCUSSION

Our study shows that the most common site of brainstem injury was midbrain hemorrhage followed by hemorrhage in pons and medulla. Kumar et al[11] analysis of 71 cases of head injury. Of them 28 cases had brainstem hemorrhage. Nineteen cases had mid-brain hemorrhage, six cases had pontine hemorrhage, three cases had medullary hemorrhage. It has been seen that the tearing of basilar vessels play a crucial role brainstem hemorrhage. Meyer et al in his study reports that the most common site of hemorrhage was the ventral-rostral midbrain. This is located adjacent to the interpeduncular cistern[6]. Ropper et al[12] reported that among five patients having traumatic midbrain hemorrhage. These patients were in a comatose state with dilated pupils, absent limb tone and impaired horizontal eye movements. Ropper et al[12] further reports that computed topography delayed the visualization of midbrain hematoma however the wave V abnormalities of brainstem auditory evoked potentials helped in the early diagnosis. Mannion et al[13] reported 46 patients with traumatic brain injury were admitted to the emergency department during his study duration, of them 13 had brain stem lesions. Eleven of these 13 patients underwent a persistent vegetative state and five of them died. He further reports that there is a statistically significant lesion between brain stem injury and unfavorable outcome. Britt et al[14] reports a traumatic series with 162 patients with fatal head injuries. Of these patients 41 had primary brain stem injury. Majority of brain stem lesions in these patients were at the ponto-medullary junction and the cause was rapid hyperextension at this point which caused stretching and tearing of vessels and brain parenchyma. The involvements of bilateral upper pontine lesions are directly related to the decreased rates of survival. Brainstem lesions are directly linked to survival chances unlike lesions in other areas of the brain[15].

Tsai et al[16] in their study concluded that the mortality and morbidity among patients with traumatic brainstem injury is twice or thrice more than that associated with transtentorial herniation and absence of brainstem injury. Hashimoto et al in his study reports that 21 of 239 patients with head injury had primary brain stem lesions. Of these cases, five patients were found to have involvement of only brainstem. Sixteen cases had brainstem injury along with injury to other brain structures such as cerebral contusions, interventricular hemorrhage, subarachnoid hemorrhage and callosal injuries[4].

The most common mode of injury in our study was road traffic accidents. Moving head offers greater resistance. Acceleration and de-acceleration forces are greater. Shukla et al[17] in his study reports the brainstem and hypothalamic lesions among 47 patients with head injury. The most common mode of injury in his study was road traffic accidents followed by falls. In his study brainstem lesions were found in 36 patients. They further reports that the site of impaction has no impact on the site of lesion.

There are various prognostic markers developed for the diagnosis and management of patients with traumatic brain stem injury. The most common are presence of skull fracture and presence of mass lesions. The prognostic marker at the time of admission is patient's age as age greater than 60 years is associated with poor prognosis. Other markers which can influence the prognosis include the gender, presence of co-morbid conditions like diabetes mellitus or hypertension and having a history of alcoholism[18]. The prognostic markers are different with children as presence of skull fractures is associated with a relatively better prognosis as the distribution of kinetic energy reduces the damage[19]. Hilario et al[20] has concluded from his study results that non-hemorrhagic lesions of brainstem are associated with a good prognosis however

posterior and bilateral brainstem injuries are associated with poor prognosis.

In usual cases, computed tomography (CT) scans are used for the evaluation of lesions. However, studies have suggested that auditory brainstem response is also useful to detect brainstem lesions[21].

CONCLUSION

Most common site for hemorrhage in brainstem was midbrain followed by pons and medulla. Traumatic brainstem injuries are often associated with lesions at other sites of brain and poor prognosis. The most common mode of injury in our study was road traffic accidents. Patients are either dead to undergo persistent vegetative state.

REFERENCES

1. Thompson RK, Salcman M. Brain stem hemorrhage: historical perspective. Neurosurgery 1988;22(4):623-8.
2. Andrioli GC, Zuccarello M, Trincia G, Fiore DL, De Caro R. Traumatic primary brain stem haemorrhage. Acta Neurochirurgica 1983;67(1-2):103-13.
3. Firsching R, Woischneck D, Klein S, Ludwig K, Döhring W. Brain stem lesions after head injury. Neurol Res 2002;24(2):145-6.
4. Hashimoto T, Nakamura N, Richard KE, Frowein RA. Primary brain stem lesions caused by closed head injuries. Neurosurg Rev1993;16(4):291-8.
5. Klintworth GK. The pathogenesis of secondary brainstem hemorrhages as studied in an experimental model. Am J Pathol 1965;47(4):525.
6. Meyer CA, Mirvis SE, Wolf AL, Thompson RK, Gutierrez MA. Acute traumatic midbrain hemorrhage: experimental and clinical observations with CT. Radiology 1991;179(3):813-8.
7. Firsching R, Woischneck D, Klein S, Ludwig K, Döhring W. Brain stem lesions after head injury. Neurol Res 2002;24(2):145-6.
8. Crompton MR. Brainstem lesions due to closed head injury. Lancet 1971; 297(7701): 669-73.
9. Rosenblum WI, Greenberg RP, Seelig JM, Becker DP. Midbrain lesions: frequent and significant prognostic feature in closed head injury. Neurosurgery1981;9(6):613-20.
10. Crompton MR. Hypothalamic lesions following closed head injury. Brain 1971;94(1):165-72.
11. Kumar V, Kumar A, Hallikeri VR. Autopsy and histopathological analysis of 28 cases of traumatic brainstem haemorrhages. Iranian JToxicol2012;5(15):551-3.
12. Ropper AH, Miller DC. Acute traumatic midbrain hemorrhage. Ann Neurol 1985;18(1):80-6.
13. Mannion RJ, Cross J, Bradley P, Coles JP, Chatfield D, Carpenter A, et al. Mechanism-based MRI classification of traumatic brainstem injury and its relationship to outcome. J Neurotrauma 2007;24(1):128-35.
14. Britt RH, Herrick MK, Mason RT, Dorfman LJ. Traumatic lesions of the pontomedullary junction. Neurosurgery 1980;6(6):623-31.
15. Firsching R, Woischneck D, Klein S, Reissberg S, Döhring W, Peters B. Classification of severe head injury based on magnetic resonance imaging. Acta Neurochirurgica 2001;143(3):263-71.
16. Tsai FY, Teal JS, Quinn MF, Itabashi HH, Huprich JE, Ahmadi J, Segall HD. CT of brainstem injury. Am J Roentgenol 1980;134(4):717-23.
17. Shukla D, Mahadevan A, Sastry KV, Shankar SK. Pathology of post traumatic brainstem and hypothalamic injuries. Clin Neuropathol 2007;26(5):197-209.
18. Stewart WA, Litten SP, Sheehe PR. A prognostic model for brain stem injury. Surg Neurol 1973;1(5):303-10.
19. Eder HG, Legat JA, Gruber W. Traumatic brain stem lesions in children. Child's Nervous System 2000;16(1):21-4.
20. Hilario A, Ramos A, Millan JM, Salvador E, Gómez PA, Cicuendez M, et al. Severe traumatic head injury: prognostic value of brain stem injuries detected at MRI. Am J Neuroradiol 2012;33(10):1925-31.
21. Zuccarello M, Fiore DL, Pardatscher K, Martini A, Paolin A, Trincia G, et al. Importance of auditory brainstem responses in the CT diagnosis of traumatic brainstem lesions. Am J Neuroradiol 1983;4(3):481-3.