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Original Research Article

Role of critical volume index in management of traumatic posterior fossa extradural hematoma

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ABSTRACT

Background: Posterior fossa extradural hematomas (EDH) constitutes 10% of all extradural hematomas. Before the emergence of CT scan; posterior fossa extradural hematomas were very difficult to diagnose based on clinical picture alone. Improvement in diagnostic methods, management protocols and treatment modalities have resulted in substantial reduction in mortality and morbidity and improvement in outcome.
Methods: A prospective study was conducted in Government Rajaji Hospital, Madurai Medical College; Madurai attending trauma care centre; from January 2020 to December 2021 among 30 study subjects. 6 (20%) study subjects were excluded from the study. Study subjects diagnosed with traumatic posterior fossa EDH between 18-60 years were included in the study. After evaluation, the subjects were divided into three groups namely, Group I-conservative management 16 in 66.67% cases. Group II-initial surgical management 8 in 33.33% cases. Group III-initially planned for conservative then treated with surgery 5 in 20.83% cases.
Results: Group I-GCS at admission was 13-15; 11 (68.75%) cases, 9-12; 4 (25%) cases and 3-8; 1 (6.25%) cases. Occipital bone fracture was noted in 14 in 87.5% cases. 9 in 56.25% cases had associated injuries. Total mortality was 1 in 6.25% case with GCS 3-8. Group II GCS at admission was 13-15; 1 in 12.5% case, 9-12; 5 in 62.5% cases, 3-8; 2 in 25% cases. All study subjects occipital bone fractures. Associated injuries seen in 4 in 50% cases. Mortality was seen in 3 in 37.5% study subjects. Group III- GCS after detoriation was 3-8 in 3 in 60% cases, 9-12 in 2 in 40% cases and 13-15 group had no study subjects. All study subjects had associated occipital bone fractures. Total mortality was seen in 3 in 60% cases. Equal distribution of shallow posterior fossa seen in all cases. Critical volume index is 0.032.
Conclusions: Study subjects in the conservative group who have Initial GCS of 8 to 12; initial clot volume more than 8 ml; CVI more than 0.032 should undergo surgery as an initial management option in order to obtain better prognosis and outcome.

Keywords: Posterior fossa, Extra-dural haemorrage, Critical volume index, Clot volume

INTRODUCTION

Posterior fossa injuries is uncommon and accounts for less than 3% of all head injuries.[1] Among that traumatic posterior fossa injuries extradural hematoma (EDH) is the most common, accounting for 10% of all extradural hematomas.[2]

Before the emergence of CT scan, posterior fossa extradural hematomas were rarely diagnosed in alive patients.[3] It was very difficult to diagnose based on clinical picture alone and is unfortunate since it is an easily preventable cause of mortality.[4] Posterior fossa EDH has a very high morbidity and mortality rates.[5] Improvement in diagnostic methods, management

protocols: and treatment modalities have resulted in substantial reduction in mortality and morbidity and improvement in outcome.[6] This study aimed to analyse the treatment options for traumatic posterior fossa EDH and study the correlation between safe clot volume, critical volume index and prognosis in traumatic posterior fossa EDH.

METHODS

After obtaining institutional ethical committee approval, a prospective, open label, randomized, single centered study was conducted among 30 study subjects attending Trauma care centre, Government Rajaji hospital, Madurai Medical College, Madurai meeting the inclusion and exclusion criteria over a period of 2 years (January 2020 to December 2021) after obtaining a written informed consent using a purposive sampling technique.

Inclusion criteria

Study subjects diagnosed with traumatic posterior fossa EDH between 18-60 years were included in the study.

Exclusion criteria

6 (20%) study subjects were excluded from the study. Exclusion criteria were study subjects with poor hemodynamic status, patients died before surgery, who did not complete the entire management protocol in our hospital, who had other associated intracranial head injuries and who were initially admitted in another hospital and then later referred to our hospital were excluded from the study.

A proforma was formulated to conduct this study and all the subjects enrolled in the study had their necessary parameters filled up in the proforma. The proforma contained all the necessary information required for conducting the study. Study subjects were critically evaluated for their post-resuscitation GCS, age, sex, presence or absence of focal neurological deficits, presence or absence of other associated injuries. A complete neurological examination was conducted wherever possible. All study subjects were subjected to X-ray of skull antero-posterior and Lateral view and underwent CT brain with 5 mm posterior fossa thickness slices with bone window. X-ray cervical spine and the relevant investigation of the required area was done based on the associated injuries present. All the necessary investigations were repeated as and when necessary including CT scan Brain based on clinical progress and clinical condition of the patients. Based on CT images location of the clot, volume of the clot (ml), presence or absence of mass effect on 4th ventricle with or without dilatation of ventricles, occipital bone injuries including fracture and other intracranial injuries were documented in the proforma everytime a CT brain was taken. After evaluation, the study subjects were divided into three groups namely, group I conservative management 16 (66.67%) study subjects, group II initial surgical management in 8 (33.3%) study subjects, group III initially planned for conservative then treated with surgery in 5 (20.83%) study subjects.

All study subjects in group I were planned for conservative management and periodic assessment of GCS, development of fresh focal neurological deficits, blood pressure assessment, bradycardia and respiratory abnormality were done. Routine repeat CT brain was taken at 6 hours after injury or whenever a new clinical sign developed like low GCS, bradycardia, focal neurological deficits or bradypnoea.

Study subjects who required surgery (group II) were assessed for anesthesia fitness based on hemodynamic status and blood parameters. They were subjected to surgery as early as possible. A standard sub-occipital burr hole craniectomy and clot evacuation was performed. All the information obtained during surgery were noted in the proforma. Based on the above information a master chart was prepared. Statistical analysis was done using; Chi-square test, ANOVA test, independent t-test and paired t-test.

RESULTS

Group 1

All study subjects with volume <10 ml were put on conservative management. There was a maximum case in age group 21-40 years had 9 (56.25%) cases, 41-60 years had 4 (25%) cases, <20 years had 2 (12.5%) cases, >60 years had 1 (6.25%) case (Table 1).

Table 1: Age distribution in different study groups.

Age (years)	Group I	Group II	Group III
<20	2 (12.5)	1 (12.5)	3 (60)
21-40	9 (56.25)	2 (25)	1 (20)
41-60	4 (25)	5 (62.5)	1 (20)
>60	1 (6.25)	-	-

There was a male 11 (68.75% cases) preponderance over females 5 (31.25% cases). GCS at admission was 13-15 in 11 (68.75%) cases, 9-12 in 4 (25%) cases and 3-8 in 1 (6.25%) case (Table 2). Occipital bone fracture was noted in 14 (87.5%) cases. 9 (56.25%) cases had associated injuries. Equal distribution of shallow posterior fossa was seen in this group. No evidence of hydrocephalus was noted in any of the study subjects. Total mortality was 1 (6.25%) case with GCS 3-8.

Group II

There was a maximum cases in group 41-60 years had 5 (62.5%) cases, 21-40 years had 2 (25%) cases, <20 years had 1 (12.5%) case (Table 1). There was a male preponderance 6 (75% cases) over females 2 (25%). GCS at admission was 13-15 in 1 (12.5%) case, 9-12 in 5

(62.5%) cases, 3-8 in 2 (25%) cases (Table 2). All the patients in Group 2 had occipital bone fractures. Associated injuries seen in 4 (50%) cases. Equal distribution of shallow posterior fossa seen. 2 (25%) cases had high cervical spine fractures. 3 (37.5%) patients had ventricular system dysfunction. Mortality was seen in 3 (37.5%) study subjects with GCS of 3-8 in 2 (25%) cases and GCS 9-12 in 1 (12.5%) case.

Group III

There was a <20 years age group preponderance of 3 (60%) cases, 21-40 years had 1 (20%) case, 41-60 years had 1 (20%) case (Table 1). There was a male 4 (80% cases) preponderance over females 1 (20% case). GCS after deterioration was 3-8 in 3 (60%) cases, 9-12 in 2 (40%) cases and 13-15 group had no study subjects (Table 2). All study subjects had associated occipital bone fractures. 4 (80%) study subjects had ventricular dysfunction. Total mortality was seen in 3 (60%) cases with GCS 3-8. Equal distribution of shallow posterior fossa seen in all cases.

Table 2: GCS at admission in Group I and Group II and GCS after deterioration in Group III.

GCS	Group I	Group II	Group III
13-15	11 (68.75)	1 (12.5)	-
9-12	4 (25)	5 (62.5)	2 (40)
3-8	1 (6.25)	2 (25)	3 (60)

DISCUSSION

There was an age preponderance among second to fourth decade and showed a male preponderance over females. Elderly patients had poor outcome irrespective of volume and GCS. There was no direct correlation between the size of posterior fossa and the EDH incidence[7,8]. In other words it does not appear that shallow posterior fossa or cranio-vertebral junction anomalies show a predisposition towards development of posterior fossa EDH.

Presence of cervical spine injury consistently resulted in poor outcome (p=0.032). Radiological evidence of occipital bone injury extending above or beyond venous sinuses had a higher clot volume necessitating surgical decompression and evacuation (p=0.0016). Those who presented with focal neurological deficits either on admission or developed at a later stage and mass effect on fourth ventricle or dilation of ventricles invariably had higher clot volume necessitating surgical decompression and evacuation and most of the study subjects had poor outcome (p=0.417).

Study subjects with GCS less than 7 had poor outcome irrespective of the group they are in. All study subjects with GCS more than 12 had better outcome. In conservative group; subjects with GCS of 9 to 12 constitute a high-risk group for deterioration and poor outcome, if not subjected to surgery as an initial mode of management. Clot volume of more than 12 ml had poor outcome irrespective of other factors. Clot volume of less than 6 ml had better outcome (p=0.0021). All patients in Group II had a clot volume of ten ml and above. Group III patients had initial clot volume between 8 ml and 10 ml. In our study, the safe volume for posterior fossa EDH is 8 ml rather than the usually accepted 10 ml, because all these study subjects who deteriorated and underwent surgery had poor outcome. In order to obviate the errors possible when one relies on absolute volume of EDH (because of inherent difference in the size of posterior fossa in different individuals) and because the clot volume is the single, most independent parameter in deciding surgical and non-surgical management options, it will be useful if a critical volume index be determined. This index can then be used as a guideline, irrespective of skull size.[9-11] This index will be particularly useful in those situations where the clot is not producing mass effect. Critical volume index=clot volume/posterior fossa volume. We have found out the average posterior fossa volume in adults and children from literature and also independently measured it using normal child and adult skull. For applying this index for practical purpose needs to be confirmed with larger studies. It we found that; Critical volume index is 0.032. If the index is more than 0.032, then that is an absolute independent indicator for surgical evacuation.

Regarding paediatric posterior fossa extradural hematomas and critical volume index further work needs to be done to find out the absolute volume of posterior fossa and critical volume of clot as an independent marker of surgical intervention.[12,13] But one has to take into consideration, the non-closure of sutures and malleability of the skull while calculating the absolute volume. Larger studies were needed for calculating the absolute clot volume for posterior fossa extradural hematomas.[14]

CONCLUSION

Study subjects in the conservative group who have initial GCS of 8 to 12; initial clot volume more than 8 ml; CVI more than 0.032 should undergo surgery as an initial management option in order to obtain better prognosis and outcome.

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