Original Article

Risk factors of progressive epidural hematoma in patients with head trauma

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Objective: To study the risk factors involved in the progression of epidural hematoma (PEDH) in head injury patients on serial computerized tomography (CT) scans.

Methodology: In this retrospective review of serial CT scans of 200 patients with Traumatic brain injury (TBI) clinical data was analyzed to determine various risk factors responsible for PEDH.

Results: PEDH was observed in 69.5% of 200 head trauma patients in whom two CT scans were obtained within 24 hours of injury, and in a majority of head injury patients, it developed within first 3 days after injury. It was noted that patient's gender, age, Glasgow Coma Scale (GCS) score at admission, skull fracture and mid line shift were not associated with PEDH. Whereas hypotension (OR 6.860, 95% CI 1.5903.378), coagulopathy (OR 0.002, 95% CI 0.000-0.163), clot density on CT (OR 8.472, 95% CI 6.963-9.501), clot location (OR 15.740, 95% CI 1.701-5.619), clot volume (OR 5.611, 95% CI 1.148-7.416) or decompressive craniotomy (DC) (OR 6.269, 95% CI7.42-9.24) were independently associated with an increased risk of PEDH.

Conclusion; Epidural hematoma has a greater tendency to progress soon after injury, often in rapid progression. Therefore, it is important to recognize associated risk factors and treatable cause of secondary brain injury and accordingly tailor the management of patients with PEDH. (Rawal Med J 201;40: 303-306).

Key Words: Progressive epidural hematoma, traumatic brain injury, decompressive craniotomy.

INTRODUCTION

Traumatic brain injury (TBI) is a common cause of death and disability in Pakistan. The most important secondary insult of head injury is epidural hematoma (EDH), which is considered to be an acute complication of TBI, its maximum development taking place immediately following trauma. However, there are also many reported cases of delayed and PEDH or very rare chronic epidural hematoma.[1-3] Many reports on extradural hematoma have drawn attention to avoidable factors implicated in preoperative deterioration, such as delayed transportation to the hospital and delayed diagnosis.[4,5] But less consideration has been given to the specific factors that influence the outcome of patients who arrive comatose in the operating room.[6] Extradural hemorrhage is one of the most threatening lesions in patients with craniocerebral trauma and early diagnosis is essential for its adequate management. Mortality rates are 20% or higher in most series.[7] The value of CT scan in the assessment of severe head injury is now widely recognized.[8,9] Progressive epidural hematoma (PEDH) is considered in those patients when repeat CT scans revealed development of a new hematoma or an increase in size of pre existing hematoma compared with initial CT finding. The effects of clinical variables on development of PEDH have not been previously described in detail. The aim of this study was to assess the risk factors of PEDH.

METHODOLOGY

A retrospective review of 200 TBI patients with epidural hematoma admitted in Lahore General Hospital, Lahore, Pakistan from January 2014 to December 2014 was performed. Patients who were considered open or penetrating head injury, coagulation disorder and those on a long-term anticoagulant therapy were excluded from the study. Accordingly, data of 200 patients with epidural hematoma was analyzed. Demographic data (gender and age), the time and mechanism of trauma, Glasgow Coma Score (GCS) at admission, and the time of the first CT scan printed on films

were noted.

An initial CT scan was performed with in first 24 hours and all the imaging studies were technically adequate and reviewed by an experienced radiologist. The volume of the hematoma was calculated according to standard formula.[10] Surgery was indicated in cases with midline shift greater than 5mm, volume of hematoma equal to or greater than 30 ml in supra tentorial and 10ML in infra tentorial compartment, or neurological deterioration. 2nd CT scan was performed when there was neurological deterioration or increase in ICP.

PEDH was defined as an appearance of new hematoma(s) or 25% and more increase in the size of hematoma(s) in at least one dimension of one or more lesions seen on the first CT scan. Those patients in which the dictated report noted no progression were classified as having a nonprogressive hemorrhage.[11] The Criteria for TBI-associated early coagulopathy included the presence of thrombocytopenia (PLT <100,000/ml) and/or elevated INR >1.2 and/or prolonged APTT >36 seconds at admission.[12-13] Early hypotension was defined as a systolic blood pressure (BP) lower than 90mmHg and/or diastolic pressure less than 40mmHg, before the second CT scan was performed. The indications for DC were also evaluated as a possible predictor of progressive epidural hematoma. Clot density (heterogeneous or homogenous), Clot volume, Clot location and Midline shift were also studied.

The data were analyzed using SPSS version 20. Association was assessed using χ^2 test. A binary logistic regression analysis was performed to determine the independent predictors of PEDH. Predictors were defined as being significant (P <0.05) after all predictors was added to the study. PEDH was bifurcated as positive and negative.

RESULTS

The patients' age ranged from 10 to 82 years, with mean age of 46 years; 138 (69%) patients were male and 62 (31%) were female. The mechanisms of trauma included 95 (47.5%) road traffic accident, 63 (31.5%) fall from height, 29 (14.5%) heavy strikes (patients who were hit by heavy objects such as rods, bricks, sticks), and 13 (6.5%) cases of assaults. Mean GCS score upon admission was 8.2 (range, 3-15). Mean time from injury to first CT scan was 3.2 hours and the time between first and second CT scans was 9.5 hours.

Table 1: Significance of various factors (Chi-Square test).

Variable	Value	Sig.
Gender	.131	.171
Age	.647	.714
GCS	1.396	.497
DC	24.515	.000*
Skull fracture	38.986	.000*
Coagulopathy	38.758	.000*
Hypotension	1.851	.174
Clot density	78.780	.000*
Clot location	65.071	.000*
Clot volume	128.582	.000*
Midline shift	84.154	.000*

*=p-value<0.001 **=p-value<0.005

Out of 200 patients, 139 (69.5%) developed PEDH during their hospitalization. Chi-Square analysis revealed an association between occurrence of PEDH and hypotension, coagulopathy, skull fracture, midline shift, clot volume, clot location, clot density and DC. Gender, age, admission GCS score did not influence the development of PEDH (Table 1). Hypotension (OR 6.860, 95% CI 1.5903.378), coagulopathy (OR 0.002, 95% CI 0.000-0.163), clot density on CT (OR) 8.472, 95% CI 6.963-9.501), clot location (OR) 15.740, 95% CI 1.701-5.619), clot volume (OR) 5.611, 95% CI 1.148-7.416) or DC (OR 6.269, 95% CI7.42-9.24) showed significance with PEDH.

DISCUSSION

Follow up CT scans has now become an important step in management of trauma patients. It is well recognized that early repeated CT scanning is important for detecting progress of hemorrhage, in order to timely trigger the management of the patients. Repeat CT scanning has revealed that PEDH is much more common after head trauma. Several studies have reported that early progressive hemorrhage occurred in approximately 30-42.3% of head injury patients

and it occurs most frequently in intraparenchymal contusion or hematoma.[14-16] Now it is defined on the basis of radiological criteria: epidural hematoma that is not present or only smaller in size in the first CT scan after TBI, but it appears or significantly increases in size in sequential repeat CT scan during patient admission.

In this study, PEDH was defined as an appearance of new hematoma, or a 25% or more unequivocal increase in the size of hematoma during hospitalization. The reported incidence of delayed epidural hematoma varies from 5.6% to 13.3%.[17,18] It was found that younger age patients were more prone to develop PEDH, although there was no significant association between age differential and PEDH by statistical analysis. It may be due to that the dural-based vessels are more easily torn with deformation of the skull in younger patients, but the dura becomes more adherent to the skull with advanced age, which reduces the risk of epidural hematoma. Ono et al. retrospectively analyzed 272 patients with severe head injury and suggested the GCS score was the only significant outcome prognostic factor in the PEDH group.[19]

Another finding of importance in the study was that decompressive craniotomy had independent predictive value for PEDH. Postoperative intracranial hematomas had been observed in previous reports with an incidence ranging from 7.8% to 61%.[20] After DC there is sudden release of pressure on cerebral vessels which may lead to progressive hemorrhage. Therefore, it was proposed that routine postoperative CT scan should be performed immediately after cranial surgery for head trauma, particularly in those with a skull fracture contra lateral to the original hematoma. This would help in timely detection and treatment of such a complication.

The skull fracture was not the predictor of PEDH. The relationship between skull fracture and an increased incidence of epidural hematoma or delayed epidural hematoma has been established in previous studies.[21] Piepmeier and Wagner have reported that the overall incidence of skull fractures in the patients with intracranial hemorrhages was 48%, while in those with delayed hematomas it was at least 75%.[22] However, it ws noted that skull fracture alone was not a predictive factor of PEDH by the multivariate analysis.

Our study has shown that coagulation disorder in head injury patient was an independent risk factor for PEDH. Studies by Stein et al. and Engström et al. also showed that an increase in PT and APTT and a decrease in platelets were predictive for PEDH.[23,24] However, other studies indicate that progressive hemorrhage after head injury is associated with diffuse intravascular coagulation as defined by increased concentration of fibrin degradation products or D-dimer and low fibrinogen concentration.[25] These may serve as an early marker of coagulopathy.

Associated systemic traumatic lesions leading to a low systolic pressure have been classically identified as a mechanism responsible for the delayed appearance of the epidural hematoma, a "tamponade" effect. Our analysis showed such a direct correlation of PEDH with hypotension. We speculate that resuscitation efforts and catecholamine administration in the emergency room could lead to significant variations of BP after initial hypotension, which might increase the risk of rebleeding.

CONCLUSION

The present study demonstrated that hypotension, the presence of coagulation disorder, decompressive craniotomy, clot density, location and volume were the main risk factors for the development of PEDH. Patients with PEDH have a greater tendency of elevated ICP and craniotomy is performed in almost 80% of those patients for hematoma removal. Based on these findings, we recommend routine follow-up CT scans be done immediately for all patients who deteriorate between 12 to 24 hours after admission.

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