ORIGINAL ARTICLE

INTRACRANIAL HEMORRHAGE IN PATIENTS WITH HEAD TRAUMA ON COMPUTED TOMOGRAPHY SCAN

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ABSTRACT

OBJECTIVE: To determine the frequency of intracranial hemorrhage on Computed Tomography scan in patients presenting with history of head trauma. **MATERIALS AND METHODS:** 165 patients with history of trauma were enrolled in the study, all referred for Computed Tomography scan (CT). Computed Tomography scan of brain without contrast was done in axial plane with a slice thickness of 10 mm from foramen magnum to vertex. Any abnormal findings were noted. Only first Computed Tomography scan of the patient examined was considered. A Performa was filled recording patient's name, age, sex, head injury, Computed Tomography findings etc. Any bias or confounding variable was controlled by putting some risk factors in the exclusion criteria. Patients with bleeding disorders and those on anticoagulant therapy were excluded from the study as they have increased risk of developing spontaneous intracranial hemorrhage. Data analysis was done by using SPSS version 10. Mean and standard deviation were calculated for all numerical values i.e. Age. Frequency and percentage were calculated for all categorical/qualitative variables i.e. sex, head injury, mode of injury, intracranial hemorrhage. **RESULTS:** Out of 165 patients with head injury, 25 (15.3%) showed traumatic intra cranial hemorrhage on CT scan (Table 5).Out of 25 patients, 09 (36%) had subdural hemorrhage (SDH), 05 (20%) had subarachnoid hemorrhage (SAH), 07 (28%) had epidural hemorrhage (EDH) and 04 (16%) had intra parenchymal hemorrhage (IPH). Out of 165 patients, 71 (43.1%) had road traffic accidents (RTA), 39 (23.6%) had H/o fall and 55 (33.3%) had other types of traumatic injuries i.e. firearm, blunt traumatic injury, domestic abuse. 111 patients showed no fractures of skull whereas 29 patients had fracture of skull. Among various age groups, it was observed that the highest frequency of intracranial hemorrhage was in age range 16-30 years that is in 13 out of 25 patients. Male patients showed higher incidence of intracranial hemorrhage (72%) as compared to females. Patients with history of road traffic accidents showed higher incidence. **CONCLUSION:** This study demonstrates that 15.3% of patients presenting with head trauma had intracranial haemorrhage (ICH) evident on CT scan. Subdural hemorrhage was the most frequent type of haemorrhage in this study. Intracranial haemorrhage present was mostly associated with road traffic accidents as compared to other traumatic injuries.

Keywords: Intracranial hemorrhage, Computed tomography scan, Subdural hematoma, Extradural hematoma, Subarachnoid hematoma

Introduction

Head injury is a significant public health problem. Traumatic head injuries represent the major cause of neurological disability.[1-3] Approximately 2 million traumatic brain injuries occur each year.[4] 65% of traumatic patients have head injuries.[5] Careful monitoring of injured patients is important and is

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achieved by a combination of careful clinical evaluation, imaging and electrophysiological markers. There are two general categories of head injuries: closed and penetrating. A closed injury is one in which the skull is not broken open (no skull fracture) unlike the penetrating injury where the skull is broken open (fracture). Cranial CT has been established as an accurate diagnostic modality in neuroradiology. It provides accurate non-invasive diagnosis of fractures, intracranial hemorrhages and other sequelae of head injury, like cerebral edema. Computed Tomography (CT) is the most common means used for intracranial evaluation following trauma and provides an objective assessment of structural damage to brain.[6] In trauma patients, axial non-contrast Computed Tomography is gold standard technique.[1] Frequently , prognosis can be implied from CT findings.[7] CT findings in patients with acute craniocerebral trauma may be hemorrhagic contusion, intracerebral and extracerebral hemorrhages/ hematomas, general and focal cerebral edema and shearing injury of cerebral white matter.[3,5] Presence of intracranial hemorrhage, abnormal densities in brain parenchyma, mass effect and midline shift are the diagnostic criteria for intracranial injury on CT scan.[3] Prevalence of intracranial injury is 8.3% as shown by an investigation in National energy x radiography utilization study.[9] Intracranial hemorrhage is the commonest consequence in all traumatic brain injuries.[10] Stein and Ross found frequency of intracranial hemorrhage to be 4.2% among traumatic brain injuries.[11] A study conducted in Shifa International hospital showed only 0.6% of head injured with intracranial hematoma.[12] Study performed by Roghani and Ali showed frequency of intracranial hemorrhage to be 56% out of which 95% were because of blunt head trauma and 5% because of firearm injuries.[3] This study was carried out to assess and document the pattern of CT findings in head trauma and comparison was done with findings from previous works in other centers. This study intends to elicit the age, sex, radiological characteristics of patients present with head injuries and to identify the etiologic factors of head injury. The main aim of my study is to find out the frequency of intracranial hemorrhage in traumatic head injuries. I will determine the frequency of different types of hemorrhage. Though patients' outcome is not the objective of my study however, the presence of bleed in different parts of head predicts the outcome of patients. Because of increasing incidence of road traffic accidents, risk of head trauma is being increased in our population. Road traffic accidents are seen commonly in urban areas due to congestion and heavy traffic in cities. This study has never been conducted at local level in Khyber teaching hospital Peshawar and is not being duplicated. Thus, by finding the frequency of different types of intracranial hemorrhage in patients with head trauma, the magnitude of the problem at our level will be determined. This will help in in-time treatment of the patient.

Material and Methods

STUDY DESIGN:
Descriptive (Cross-sectional study)

DURATION OF STUDY:
One year.

SAMPLING TECHNIQUE:
Non-probability purposive sampling

SAMPLE SELECTION:

INCLUSION CRITERIA:
Head trauma
All age groups
Both sexes

EXCLUSION CRITERIA:
Patients with Bleeding disorders
Patients on Anticoagulant therapy.

DATA COLLECTION:
165 patients with history of trauma were enrolled in the study, all referred for Computed Tomography scan (CT). Permission was taken from hospitals' ethical Committees. All patients meeting the inclusion and exclusion criteria coming to Radiology departments of Khyber Teaching Hospital Peshawar and Hayatabad Medical Complex, Peshawar for Computed Tomography scan, in specified period of time, were identified. They were interviewed regarding the mode

of injury and consent was taken from them or from their guardians/next of kin, if they were not conscious. Patients were divided into different age groups. Patients with age 1-15 years were included in one group, 16-30 years in second group, 31-45 years in third group and 46years and above in fourth group. Computed Tomography scan of brain without contrast was done in axial plane with a slice thickness of 10mm from foramen magnum to vertex. Any abnormal findings were noted. Only first Computed Tomography scan of the patient examined was considered. A Performa was filled by myself recording patient's name, age, sex, head injury, Computed Tomography findings etc. Any bias or confounding variable was controlled by putting some risk factors in the exclusion criteria. Patients with bleeding disorders and those on anticoagulant therapy were excluded from the study as they have increased risk of developing spontaneous intracranial hemorrhage so acted as confounding variables. Results of the study were affected if these were included in the study .So by excluding these two conditions bias is being controlled. Data analysis was done by using SPSS version 10. Mean and standard deviation were calculated for all numerical values i.e. Age. Frequency and percentage were calculated for all categorical/qualitative variables i.e. sex, head injury, mode of injury, intracranial hemorrhage. The results were presented as tables and graphs.

DATA ANALYSIS PROCEDURE:

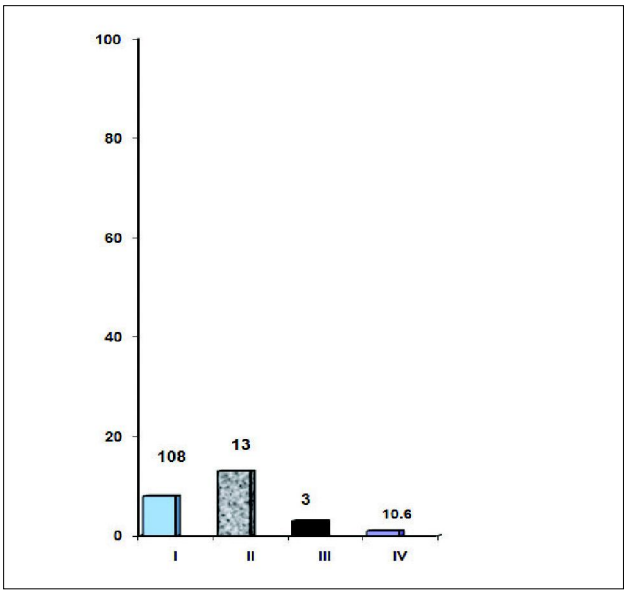
Data analysis was done by using SPSS version 10. Mean and standard deviation calculated for all numerical values i.e. Age. Frequency and percentage calculated for all categorical/qualitative variables i.e. sex, head injury, mode of injury, intracranial hemorrhage.

Results

Out of 165 patients, 51 (30.9%) had age range of 1-15 years, 58 (35.2%) had 16-30 years, 32 (19.4%) had 31-45 and 24 (14.5%) had more than 46 years (Tab. 1) (Fig. 1). Regarding gender distribution, 108 (65.4%) were males and 57 (34.6%) were females with traumatic head injury (Fig. 2). Out of 165 patients,

Age (Years)	Number of Patients	Percentage %
1-15	51	30.9
16-30	58	35.2
31-45	32	19.4
46-onward	24	14.5
Total subjects	**165**	**100**

Table 1: Age Distribution



I: 1-15 years
II: 16-30 years
III: 31 – 45 years
IV: 45 years onwards

Figure 1: Age distribution in patients with intracranial hemorrhage

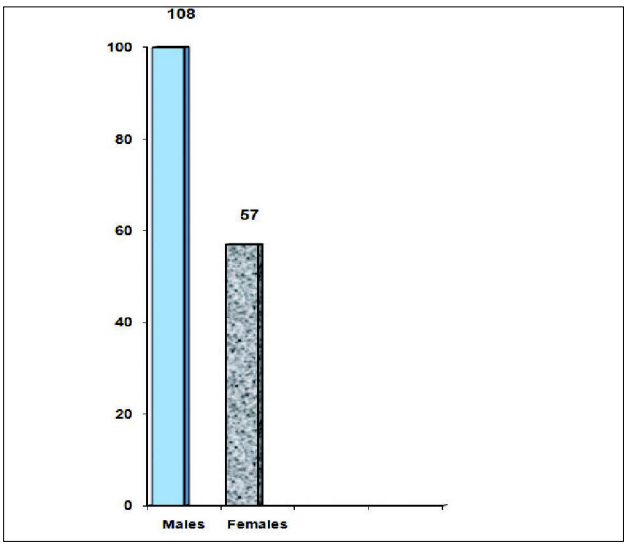


Figure 2: Gender Distribution

71 (43.1%) had road traffic accidents (RTA), 39 (23.6%) had H/o fall and 55 (33.3%) had different types of traumatic injuries i.e. firearm, blunt traumatic injury, domestic abuse (Tab. 2). 111 patients showed

Mode of Injury	Frequency	Percentage %
RTA	71	43.1
H/O Fall	39	23.6
Other mode of trauma	55	33.3
TOTAL SUBJECTS	165	100

Table 2: Mode of Injury

no fractures of skull whereas 29 patients had fracture of skull. Regarding frequency of ICH on CT scan, out of 165 patients with head injury, 25 (15.3%) showed traumatic intra cranial hemorrhage on CT scan (Tab. 3). Out of 25 patients, 09 (36%) had subdural hemorrhage (SDH), 05 (20%) had subarachnoid hemorrhage (SAH), 07 (28%) had epidural hemorrhage (EDH) and 04 (16%) had intra parenchymal hemorrhage (IPH) (Tab. 3). Out of 165 patients, 29

CT scan findings	No. of Patients (Total patients with ICH =25)	Frequency %
Subdural Hemorrhage (SDH)	09	36
Subarachnoid Hemorrhage (SAH)	05	20
Epidural Hemorrhage (EDH)	07	28
Intra parenchymal Hemorrhage (IPH)	04	16
Total	25	100

Table 3: Frequency of traumatic intracranial hemorrhage on CT scan

(17.6%) patients had fracture of cranial bones without ICH while 111 (67.3%) patients were without any fracture / ICH. Among various age groups, it was observed that the highest frequency of intracranial hemorrhage was in age range 16-30 years that is in 13 out of 25 patients. Male patients showed higher incidence of intracranial hemorrhage (72%) as compared to females (Tab. 4). Out of 25 patients with intracranial hemorrhage, patients with history of road traffic accidents showed higher incidence. (Tab. 5)

Gender	Patients with intracranial hemorrhage	Frequency %
Males	18	72
Females	7	28

Table 4: Gender distribution in patients with Intracranial Hemorrhage

Mode of Injury	Patients with intracranial hemorrhage	Frequency %
RTA	12	48
H/O fall	7	28
Other trauma	6	24
Total patients with intracranial hemorrhage	25	100

Table 5: Mode of injury in patients with intracranial hemorrhage

Discussion

Head injury is a major cause of morbidity worldwide.[13] Traumatic head injuries represent the major cause of neurological disability.[14] Approximately 65% of traumatic patients have head injuries.[3,4] Approximately 52,000 US deaths per year result from traumatic brain injury13. The annual rate of head injuries in Pakistan is 81 per 100,000 with a mortality rate of 15%.[15] Intracranial hemorrhage is a common and serious consequence of head injury.[5] Computed Tomography is the most common means used for intracranial evaluation following trauma and provides an objective assessment of structural damage to brain.[5] In traumatic patients, axial non-contrast Computed Tomography is gold standard technique.[16] Computed Tomography findings in patients with acute trauma may be hemorrhagic contusion, Intracerebral and extra cerebral hemorrhages/ hematomas, general and focal cerebral swelling and shearing injury of cerebral white matter. On Computed Tomography scan, presence of intracranial blood, mass effect and midline shift are the diagnostic criteria for intracranial injury.[17]

In this study, 165 patients were included which were referred to radiology department from emergency reception and neurosurgery OPDs. These 165 cases were evaluated by non contrast CT scan of head to evaluate the presence of any intracranial hemorrhage.

Out of 165 patients, 25 were found to have intracranial hemorrhage. The frequency was 15.3%. These results were compared with multiple studies.[18,19] It has been shown in various studies that non contrast CT scan is highly accurate in diagnosing intracranial hemorrhage. By diagnosing the presence of intracranial hemorrhage, it is possible to provide in-time management to the patients.[18]

The objective of our study was to find the frequency of intracranial hemorrhage in patients with head trauma. The results were compared with multiple studies. In a study performed by Racadio et al, it was found that 46% of patients had intracranial hemorrhage. Whereas a study conducted at Shifa International hospital in 2008 showed only 0.6% of cases of head injury had intracranial hemorrhage.[9] In the crash trial which was the largest trial conducted among traumatic head injury patients, 56% of the patients had some type of intracranial hemorrhage and 27% had subdural haemorrhage which is higher to the incidence reported in this study.[17] Our study showed about 15 % patients with intracranial hemorrhage which is higher than the study conducted in Shifa but lower than studies performed by Racadio et al. Rosenthal and colleagues scanned head trauma patients at hospital admission and found that 16% of patients had intracranial hematomas.[15] These results are comparable to our study as in this study the incidence is 15%. Similarly, Ruiz et al found that traumatic intracranial hemorrhages were found in 23% of 160 head injury patients.[16] More recently Russo and colleagues reported a study in which they included patients with traumatic brain injury and showed that 51% patients had intracranial hematomas. These studies show a higher incidence of intracranial hemorrhages as compared to this study.

In our study, commonest type of intracranial hemorrhage was subdural hemorrhage that is 36% followed by epidural hemorrhage (28%), subarachnoid hemorrhage (20%) and intra-parenchymal bleed in 16% (Fig. 3 - 6). These results are comparable to multiple studies which show the higher incidence of subdural hematomas in trauma patients as compared to other types of intracranial bleeds. A study performed by Ravindran et al showed 20% of patients with subdural hematomas.[20] In another study conducted in 2010, which included 9 randomized clinical trials in trauma head patients, the range of frequency for EPH and SDH was 7-8% and 8-9% respectively, which is comparable to the frequency reported in this study.[18] These results are consistent, but more precise, than those of previous studies showing that intracranial hemorrhage is associated with increased mortality.[15,16] In another study it was shown that subdural hemorrhage was present in 30% of the patients and epidural

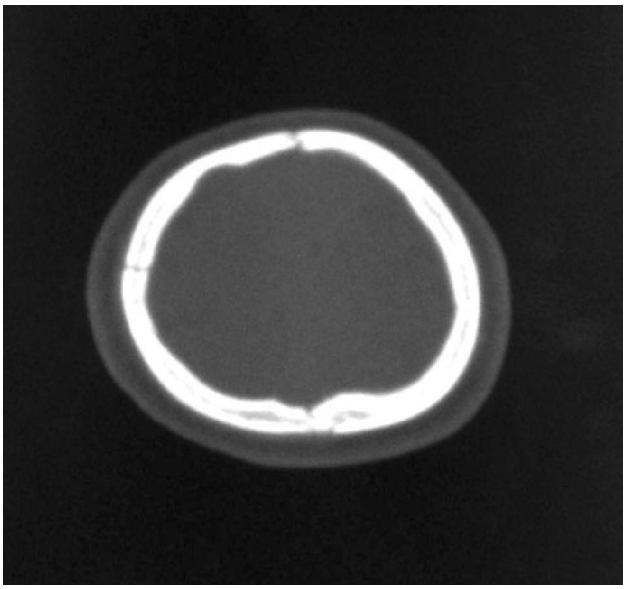


Figure 3: Axial CT scan at bone window level showing linear fracture of right frontal bone.

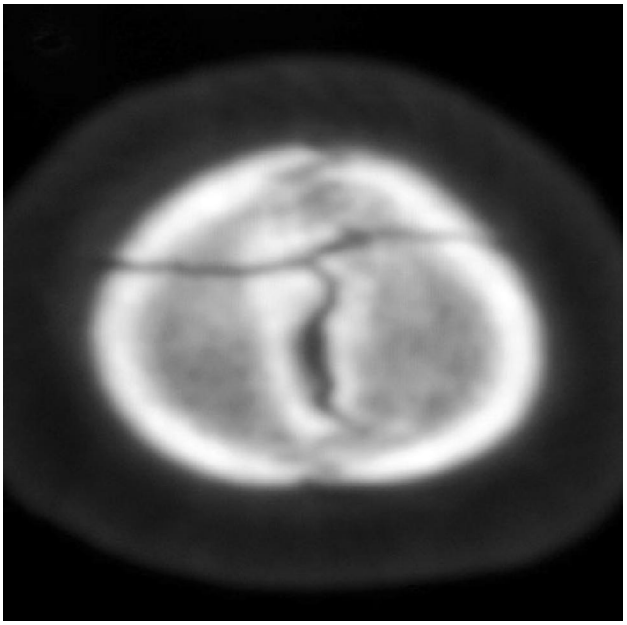
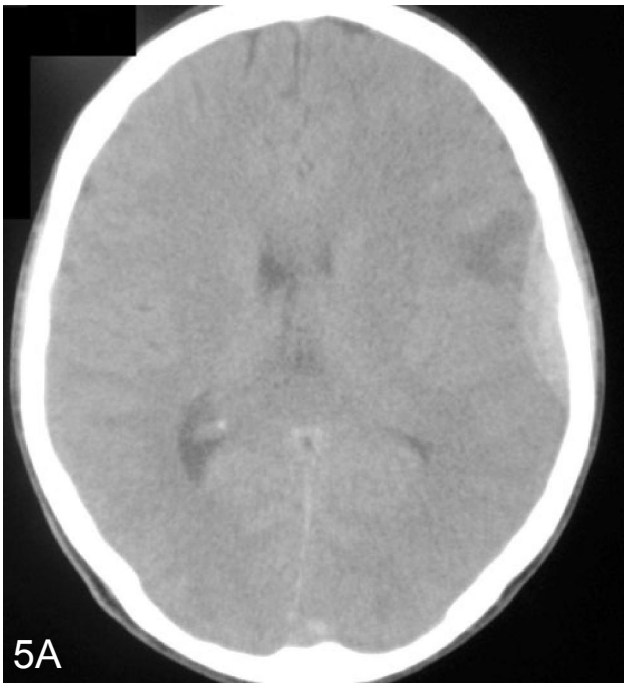


Figure 4: Bone window of a CT scan image showing linear oblique fracture involing bilateral parietal bones at vertex and sagittal suture. It is important to include the vertex to diagnose such hidden fractures.



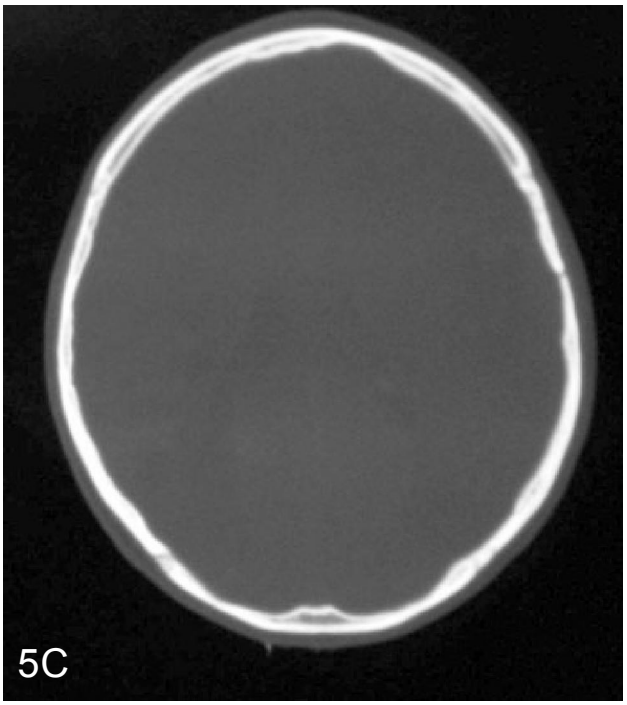


Figure 5: (a) Axial CT brain image of a trauma patient showing left parietal extradural hematoma and adjacent small insular contusion. (b) Small scalp hematoma also appreciated on enlarged image (c) Fracture of overlying bone visualized on bone window.

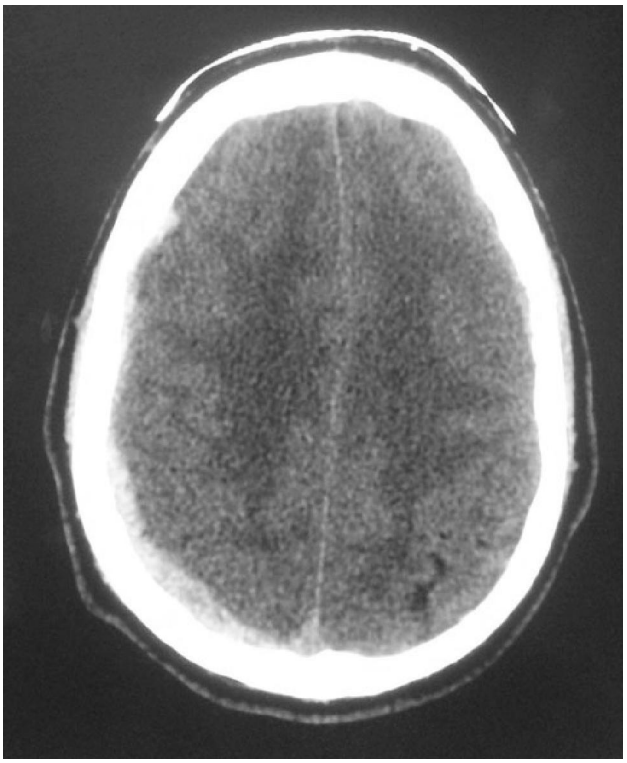


Figure 6: CT scan brain showing small hyperdense subdural hematoma along right cerebral convexity

and intraparenchymal bleeds in approximately 22% each respectively.[21] In a study conducted at Radiology Department, Dow University of Health Sciences in 2009, it was seen that the incidence of extradural hematoma was 48 % and the highest as compared to other types of hemorrhage.[15] This was against the

results of my study which showed the highest incidence of subdural hematomas. In another study conducted by Rashid et al, it was seen that the incidence of subdural hematomas was higher i.e. 22 out of 38 patients (58%) with intraparenchymal bleed being 39%.[22] In a study conducting analysis of over 13,000 patients with traumatic brain injury, it was shown that patients with a large EDH, SDH or IPH have a substantially higher mortality than patients with either no bleeding or a small bleed.[23] Even after adjusting for other CT findings, such as contusions and brain swelling, and other potential confounding variables, such as age, large bleeds substantially increase the probability of death. Small intracranial hemorrhage is not associated with an increase in mortality after adjustment for other potentially confounding variables.[24]

Out of all head trauma cases 65.4% were males and 34.6% were females. The reason behind this can be that males are on the road in major part of the day for work or other purpose. This is in keeping with the general life-styles, occupational and social interaction. In Peshawar, due to dominance of Islamic law and observation of pardah, females are seldom seen on roads. This predominance of males in trauma head patients was compared to a study performed in Dow University Karachi which showed that of all the patients presenting with head trauma 90% were males and 10% were females.[15] In our study, out of 165 patients with head trauma, largest number of people was in the age group 16-30 years. This age group people are mostly students, young laborers or conductors on buses. The higher incidence of trauma in these patients indicates that this age group is prone to more traumas as compared to other age groups. This is comparable to a study showing higher incidence of head trauma in age group 18-40 years.[15]

The commonest cause of head trauma in our study was road traffic accidents. Because of increasing incidence of road traffic accidents, risk of head trauma is being increased in our population. Road traffic accidents are seen commonly in urban areas due to congestion and heavy traffic in cities. This high incidence of head trauma with road traffic accidents is also proven in multiple studies. A study showed that the commonest mechanism of head injury was road traffic crashes.[13]

Out of 165 patients with head trauma, 17% had skull fractures without any evidence of intracranial bleed. This was comparable to a study showing frequency of fractures in head trauma patients to be 21%.[13] Bleeding size was taken into account to recommend surgical evacuation. However, the evidence presented in the guideline is very limited. For EDH the guideline reported only seven studies that evaluated the effect of size on outcome.[19] It is found that only large intracranial bleed, wherever the location (EDH, SDH or IPH) are associated with worse outcome and that large bleeds are associated with an increased risk of death in comparison with small volume intracranial bleeds.[1]

The strength of this analysis is that it included 165 patients with traumatic brain injury and so the precision of our estimates of the risk associated with intracranial haemorrhage is high. We also adjusted for most of the relevant potential confounding variables.[24] Though patients' outcome is not the objective of my study however, presence of intracranial bleed predicts the outcome of patients. There is some evidence that bleeds could enlarge in the 24-48 hours after injury. Rose and colleagues studied patients in whom two CT scans were obtained within 24 hours of injury to determine the prevalence of progressive bleeding.[14] Among patients who had their first scan within 2 hours of injury, 49% had radiological evidence of progressive bleeding. Further studies are needed to clarify the timing of intracranial hematoma expansion. A large cohort of traumatic head injury patients with an early CT scan and a second CT scan within 24-48 hours including patients with a range of trauma head severity is needed to clarify the natural history and prognostic role of traumatic progressive intracranial haemorrhage.

Conclusion

We conclude in our study that the incidence of intracranial haemorrhage in head trauma patients is 15.3%. Subdural haemorrhage was the most frequent type of haemorrhage in this study. Intracranial haemorrhage present was mostly associated with road traffic accidents as compared to other traumatic injuries.

Recommendations

1. In perspective of my results, it is recommended that non contrast CT (NECT) scan should always be the first investigation in patients with head trauma for in time management of the patient. As the scan time is less and no hazard of contrast reaction is there, it is recommended even in unconscious patients and patients with allergies.

2. Most cases with intracranial hemorrhage were those following road traffic accidents; cases with domestic trauma were minimal. Patients coming with history of trauma should be assessed in detail so that due to social problems patient does not withhold any information regarding the mode of injury.

3. A follow up NECT scan should be done at 24 to 48 hr interval to look for the expansion in size of the hemorrhage.

4. Government should promote educational campaigns on the use of seat belts and crash helmets. Federal road safety commission and the police should intensify monitoring, to ensure compliance with seatbelt, crash helmet usage and drunken driving.

5. Appropriate medical care facilities including neurosurgical centers need to be established at teaching hospitals with availability of CT scan.

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