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INCIDENCE OF PROGRESSIVE HEMORRHAGIC INJURY IN PATIENTS PRESENTING WITH TRAUMATIC BRAIN INJURY AT A LARGE TERTIARY CARE HOSPITAL IN KARACHI, PAKISTAN. A CASE SERIES.

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ABSTRACT… Objectives: Our study aims to determine the frequency of progressive hemorrhagic injury as observed on the CT scan from the initial scan performed at the time of presentation to a subsequent one in the 12 hours after the initial scan. **Study Design:** The type of study is a prospective observational case series. **Setting:** At Tertiary Care Hospital in Karachi, Pakistan. **Period:** 3 months from June 2018 to August 2018. **Materials & Methods:** All patients over 18 years of age who presented to the Accident and Emergency Department of the hospital with traumatic brain injury and had a CT scan performed within four hours of the injury were included in the study. A predesigned proforma was used to note down patient findings. CT scan findings were classified as subdural hematoma (SDH), intraparenchymal contusion (IPC) extradural hematoma (EDH) and subarachnoid hemorrhage (SAH). A repeat CT scan was performed twelve hours after the initial CT scan. Data were analyzed using IBM SPSS version 20.0, mean and frequencies were calculated for continuous variables while frequencies and percentages were calculated for categorical variables. **Results:** Of the n= 110 patients in our study 79 were males and 31 were female, the mean age of the patients was 34.25 years. The Glasgow Coma Scale scores at the time of arrival were between thirteen and fifteen for n= 33 (30%) of the patients, between nine and twelve for n= 54 (49.09%) of the patients, less than and equal to eight for n= 23 (20.90%) of the patients. Subarachnoid hemorrhage was present in n= 32 (29.09%) patients, intraparenchymal hematoma was present in n= 42 (38.18%) of the patients, while subdural hematoma and epidural hematoma was present in n= 14 (12.72%) and n= 22 (20%) of the patients respectively. Progressive hemorrhagic injury was found in n= 66 (60%) of the patients, while in n= 11 (10%) of the patients there was resolution of the lesion and n= 33 (33%) of the patients showed no observable changes in the repeat CT scan. Finally, our results indicate that of the 110 patients in our study PHI was seen in n= 17 (53.12%) patients with SAH, n= 18 (81.81%) patients of EDH, n= 5 (35.71%) patients of SDH and n= 26 (61.90%) patients of IPC respectively. **Conclusion:** According to the results of our study PHI is observed in 60% of the patients with a traumatic brain injury observed within the initial 12 hours after injury, and epidural hematoma and intraparenchymal contusions had the highest incidences of PHI among all the different types of traumatic brain injuries.

Key words: Brain Lesion, Craniotomy, CT Scan, Progressive Hemorrhagic Injury, PHI, Traumatic Brain Injury.

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INTRODUCTION

One of the most disabling injuries a human being can incur is traumatic brain injury (TBI), as it leads to physical, behavioural and psychological morbidity and often results in mortality as well.[1,2] Around the globe 10 million people have suffered from this debilitating condition.[3] Traumatic brain injuries are classified into primary and secondary lesions. The primary brain lesions occur due to direct trauma which may cause hematoma formation or direct axonal injuries such as contusions, while the secondary lesions are more complex and can lead to cerebral edema and herniation. The complexity of these lesions requires that traumatic brain injuries be dealt with caution and care, providing cerebral oxygenation,

maintaining perfusion and intracranial pressures to prevent secondary injuries.[3] Doughty in 1938 coined the term 'delayed intracranial hemorrhage' which became widely known after the advent of the Computer tomography scan (CT scan) in the 1970s.[4] It is a well-recognized phenomenon and occurs in 10% to 85% of the cases of TBI. It is also known as progressive hemorrhagic injury.[5,6,7,8,9,10] CT scan modality is used for quick assessment of acute head trauma and informs management of the patients. It informs the surgeon if the patient required decompressive surgery or conservative monitoring.[11] It is commonplace to have repetitive CT scans done at different time intervals to observe the progression of the injury. However the literature is varied when it comes to the timing of the repeat CT scan. Some studies report against using multiple CT scans at various time intervals in the absence of any neurological deterioration.[12,13] Our study aims to determine the frequency of deterioration as observed on the CT Scan from the initial scan performed at the time of presentation to a subsequent one in the 12 hours to figure out the prognostic value of observed deterioration in the repeat CT scan.

METHODS

The type of study is a prospective case series that was performed for a period of 3 months from June 2018 to August 2018 at a large tertiary care hospital in Karachi, Pakistan. The study was approved by the hospital ethics committee, and all the patients (or their caregivers when necessary) required informed consent to be part of the study. All patients over 18 years of age who presented to the Accident and Emergency Department of the hospital with traumatic brain injury and had a CT scan performed within four hours of the injury were included in the study. Patients having extra cranial injuries were also included, however we will not be commenting on those injuries, similarly patients having multiple injuries were also included and analyzed, and considered each injury individually when analyzing for evolving lesions. Patients above 75 years of age, having other neurological comorbidities and having a previous TBI within the last year, or requiring immediate surgical intervention were excluded from the study. We also excluded patients who had a normal CT scan on presentation and evolved a lesion on the repeat CT scan. A predesigned proforma was used to note down patient findings including demographic data, a complete history and physical examination including any neurological findings, Glasgow coma scale (GCS) scores, CT scan findings and any relevant laboratory investigation findings. The GCS values of less than and equal to eight were considered as a severe head injury, between nine and twelve was considered as moderate head injury and a GCS score between thirteen and fifteen was considered to have a mild injury. CT scan findings were classified as subdural hematoma (SDH), intraparenchymal contusion (IPC) extradural hematoma (EDH) and subarachnoid hemorrhage (SAH). After the initial CT scan and management in the Emergency Department, the patients were admitted to the Department of Neurosurgery and observed for any neurological deterioration. A repeat CT scan was performed twelve hours after the initial CT scan in the Emergency Department. We considered several factors to be the deciding factor to do a repeat CT scan. Factors such as no neurological improvement after initial management, potentially deteriorating lesions observed in the first CT scan and deterioration of the neurological status of the patient. A total of n= 110 patients were included in our study. Data were analyzed using IBM SPSS version 20.0, mean and frequencies were calculated for continuous variables while frequencies and percentages were calculated for categorical variables. Since our study is an observational study we did not perform any complicated statistical analysis.

RESULTS

Of the n= 110 patients in our study 79 were males and 31 were female, the mean age of the patients was 34.25 years. Of the total patient population n= 92 (83.63%) sustained a traumatic brain injury due to a road traffic accident, n= 9 (8.18%) experienced physical trauma due to an assault, where the rest of the patients n= 9 (8.18%) had a traumatic brain injury due to a fall from height. The Glasgow Coma Scale scores at the time of arrival were between thirteen and fifteen for n= 33 (30%) of the patients, between nine and twelve for n= 54 (49.09%) of the patients, less

than and equal to eight for n= 23 (20.90%) of the patients. Subarachnoid hemorrhage was present in n= 32 (29.09%) patients, intraparenchymal hematoma was present in n= 42 (38.18%) of the patients, while subdural hematoma and epidural hematoma was present in n= 14 (12.72%) and n= 22 (20%) of the patients respectively. For all the patients repeat CT scan was done after 12 hours of the initial scan, and they were observed in the department during that time period. Progressive hemorrhagic injury was found in n= 66 (60%) of the patients, while in n= 11 (10%) of the patients there was resolution of the lesion and n= 33 (33%) of the patients showed no observable changes in the repeat CT scan. Of the patients who suffered from progressive hemorrhagic injury n= 15 (22.72%) had mild traumatic brain injury, n= 39 (59.09%) had moderate traumatic brain injury and n= 12 (18.18%) had severe traumatic brain injury at the time of arrival.

In the patient population displaying a resolution of their initial lesion on repeat CT scan n= 1 (9.09%) had severe head injury, n= 3 (27.27%) had moderate brain injury and n= 7 (63.63%) had mild brain injury respectively. Of the patients who showed no observable change in their CT scan n= 11 (33.33%) had mild traumatic brain injury, n= 13 (39.39%) had moderate traumatic brain injury and n= 9 (27.27%) had severe traumatic brain injury respectively. Of the n= 66 patients who had PHI, n= 48 of them underwent surgery, and PHI was observed in n= 45 (93.75%) of the patients. Of these patients n= 10 (20.83%) had SAH, n= 16 (33.33%) had EDH, n= 18 (81.81%) had SDH and n= 16 (33.33%) had IPC respectively. Finally, our results indicate that of the 110 patients in our study PHI was seen in n= 17 (53.12%) patients with SAH, n= 18 (81.81%) patients of EDH, n= 5 (35.71%) patients of SDH and n= 26 (61.90%) patients of IPC respectively. All these patients showed an increase in the size of the hemorrhagic lesion. The overall mortality rate of our patient population was n= 5 (4.54%). A summary of the results is provided in Table-I. While Figure-1, shows CT scan image of a patient who had suffered from traumatic brain injury after a road traffic accident. The two picture show CT scans 12 hours apart, showing the evolving lesion.

Variable	Frequency	Percentage	Mean	Standard Deviation
Age in years			34.25	6.3
Gender				
Male	79	71.81%		
Female	31	28.18%		
Cause of initial injury				
Road Traffic Accidents (RDAs)	92	83.63%		
Fall from height	9	8.18%		
Assault	9	8.18%		
Other	0	0		
Initial presentation diagnosis				
Subarachnoid hemorrhage	32	29.09%		
Intra-parenchymal hematoma	42	38.18%		
subdural hematoma	14	12.72%		
epidural hematoma	22	20%		
CT Scan findings after 12 hours				
Progressive hemorrhagic injury	66	60%		
Resolution of the lesion	11	10%		
No change observed	33	33%		
GCS Scores at arrival				
13 – 15	33	30%		
09 - 12	54	49.09%		
≤ 8	23	20.90%		

Table-I. Demographic and other characteristics of the patient population (n=110):

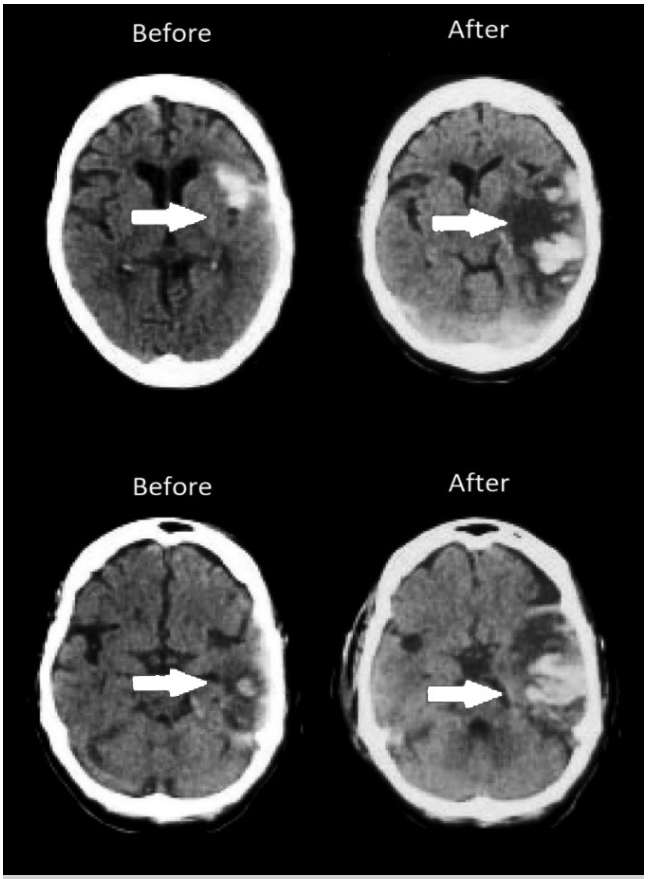

Figure-1. Showing initial CT scan and repeat CT scan of a patient (showing two sections side by side):

DISCUSSION

Among adolescents and young adults, traumatic brain injury has been recognized as a cause of disability and mortality.[8,14,15,16] The worldwide incidence is 106 per 100,000 and is expected to increase.[16] The cause of traumatic brain injury changes according to the age range of the patient population. At the extremes of age, fall from height is the common reason, whereas motor vehicle accidents are more common in patients between the ages of 14 to 35 years of age. Other causes are assaults, sports-related injuries, blunt trauma, and gunshot wounds.[3] Traumatic Brain injury can be of two types primary and secondary, the primary injuries result after direct trauma and include hematomas and axonal injuries, in any case traumatic brain injury can have a sequentially worsening course, which requires early diagnosis and management for successful treatment.[3,17] CT-scan has been established is the primary diagnostic modality that recognizes both primary and secondary TBI. CT scan is also useful in identifying the evolution of the injury. CT is ideal to diagnose traumatic brain injury as it provides rapid results, is easily available and sensitive towards the findings, it is also being used to predict patient outcomes.[3] There is debate on the indication of CT scan, however in Pakistan most hospitals perform CT scan in patients having mild or moderate traumatic brain injury.[18,19,20] In our center the neurosurgery residents and neurosurgeons order CT scans for all the patients having symptoms of neurological injury, cerebral edema, bleeding from orifices such as ears, oral and nasal cavity, GCS score less than 15 at the time of arrival with an additional sign and symptom of traumatic brain injury. Various terms have been used in literature to elicit the phenomenon of change in lesion with time as the injury evolves, terms such as traumatic intracerebral hemorrhage, PHI and hemorrhagic progression of a contusion respectively.[7, 8, 21]

In our study we have used the term PHI or progressive hemorrhagic injury as it is encompassing of different times of traumatic brain lesions. According to the results of our study PHI was observed in 60% of the patients in subsequent CT scans as performed after 12 hour of the initial scan, which was performed within four hours of the injury. The two types of injuries which are more prone to progression are epidural hematomas and intraparenchymal hemorrhage/ contusion showing an incidence of 81.81% and 53.12% respectively. In a study by Servadei et al comprising of 37 patients, 59.5% of the patients had PHI on CT scans after 12 hours of admission and required surgical treatment.[22] In a study by Oertel et al who studied 142 patients found PHI incidence in 42.3% of the patients with the highest incidence in intraparenchymal contusions (51%) when the first computer tomography scan was performed within 2 +/- 1.6 hours of injury and follow up CT scans being performed at 6.9 +/- 3.6 hours.[8] Narayan et al in their prospective study reported a 50% augmentation in hemorrhagic lesions of 2ml of larger in size when CT scans were done after 24 hours of injury.[7] Their results indicate that larger lesions are more prone to

increasing with time with an observable clinical impact as well. A similar study conducted to evaluate the incidence of PHI in patients having subarachnoid hemorrhage showed an incidence of 58.9% after 12 to 24 hours of initial CT scan.[23] A study by Servadei et al showed an incidence of 66% of PHI in patients with subarachnoid hemorrhage.[24] Alahmadi et al in their retrospective study of patients having intraparenchymal contusions observed an incidence of 45% of PHI progression and they defined the evolution as a growth of contusion size by 30%.[25]

According to the results of our study we found that PHI can occur with both severe traumatic brain injury (GCS score of less than and equal to 8) and moderate traumatic brain injury with a GCS score between 9 and 12. The evolution and progression of the lesion was dependent on its initial size having a positive correlation with it. Sifri et al showed in their study that PHI can also occur with a mild head injury observed on subsequent CT scans.[26] We propose that CT scans should be performed in patients with traumatic brain injury within the first four hours of injury, and emergency room physicians and neurosurgeons should be looking for signs of deterioration, poor response to management, or the presence of large contusions or hematoma's on CT scan to order a second CT scan to be performed 12 hours after the initial scan. Having this repeat CT scan would help the surgeons in determining the need for surgical evacuation of the hematoma or relieving the intracranial pressure, which would result in improved patient outcomes.

CONCLUSION

According to the results of our study PHI is observed in 60% of the patients with a traumatic brain injury observed within the initial 12 hours after injury, and epidural hematoma and intraparenchymal contusions had the highest incidences of PHI among all the different types of traumatic brain injuries.

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