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ORIGINAL ARTICLE

A Study on Pattern of Coup-contrecoup Head Injury in Autopsy Cases

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Abstract :

Head injuries constitute a significant number of cases brought to the casualty department of a hospital and also contribute majorly to deaths caused by transportation injuries. Understanding the mechanism and patterns of such injuries and their relation with the manner of infliction is of utmost importance to formulate preventive measures. This study was conducted to throw light on the dynamics and pattern of coup and contrecoup head injuries. A total of 263 cases fulfilling the inclusion criteria were studied prospectively with a male preponderance of 86%. Majority of the subjects were in the age range of 21 to 30 years (20.91%) followed by the age range of 41 to 50 years (17.87%). The most common pattern of injury was subdural haemorrhage (SDH) only followed by presence of both SDH and subarachnoid haemorrhage (SAH). Among 263 cases studied, At the time of impact, in 249 cases head was in a state of motion and in 14 cases, at rest. Statistical analysis concluded that proportion of contre-coup injury is more in cases where head was in motion during impact. Brain contusion was also seen more in cases of contrecoup injury than coup injury.

Keywords: Coup injury; Contrecoup injury; Motion; At rest; Impact; Road traffic accidents; Fall from height.

Introduction :

Of all regional injuries, those of the head and neck are the most common and most important in forensic practice.

Adelson (1974) gives these sound reasons for this dominance of head injuries:[1]

- The head is the target of choice in the great majority of assaults involving blunt trauma.
- When the victim is pushed or knocked to the ground, he often strikes his head.
- The brain and its coverings are vulnerable to degrees of blunt trauma that would rarely be lethal if applied to other areas.

A sound practical understanding of the neuropathology of trauma is more essential to the forensic pathologist than any other aspect of her subject, as head injuries provide the major contribution to death in assaults, falls and transportation accidents.

In head injury, a coup injury occurs under the site of impact with an object, and a contrecoup injury occurs on the side opposite the area that was hit. Coup and contrecoup injuries can occur individually or together. Coup and contrecoup injuries are considered focal brain injuries, those that occur in a particular spot in the brain, as opposed to diffuse injuries, which occur over a more widespread area. The exact mechanism for the injuries, especially contrecoup injuries, is a subject of much debate. In general, they involve an abrupt deceleration of the head, causing the brain to collide with the inside of the skull. It is likely that inertia is involved in the injuries, e.g. when the brain keeps moving after the skull is stopped by a fixed object or when the brain remains still after the skull is accelerated by an impact with a moving object. Additionally, movement of cerebrospinal fluid following a trauma may play a role in the injury.

Identification of the causes and modifiable factors behind these injuries is essential for better understanding to formulate preventive measures.

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Materials and methods:

Before starting the study, ethical clearance was taken from the ethical committee of the concerned institution. The study was conducted in the Police Morgue attached to the Department of Forensic Medicine and Toxicology for a period of eighteen months between 2017 and 2018. The study population included all cases with history of blunt trauma to head brought for autopsy at a Medical College and Hospital in eastern India. All decomposed bodies with softening and/or liquefaction of brain matter and bodies with gross disorganisation of skull & laceration of brain matter were excluded. A total of 263 cases were studied. The study design was descriptive, cross-sectional. After explaining the details of the study, required information was collected from the relatives using a pre-designed proforma. Police inquest papers, treatment sheets, injury reports and other relevant medicolegal documents were studied before proceeding for autopsy. After gathering information about the state of motion, position of the subjects and circumstances during the fatal incident, post mortem examination of the subjects were carried out according to the standard procedure. All injuries were carefully observed, examined and noted. The cranium was

Table 1. Showing frequency distribution of the sample according to cause of injury.

Cause of injury	Number of cases	Percentage
Road Traffic Accidents	172	65%
Fall from height	51	19%
Railway accidents	12	5%
Fall at home	20	8%
Roof fell on the subject	06	2%
Hit on the head by a blunt weapon	02	1%
Total	263	100%

Table 2. Showing distribution of cases with coup injury according to type of injury.

Type of injury (n=252)	No. of cases	Percentage
SDH	156	62%
SDH, SAH	66	26%
SDH, SAH, Contusion	15	6%
EDH, SDH	07	3%
EDH, SDH, SAH	05	2%
EDH, SDH, SAH, Contusion	03	1%

carefully examined for all injuries. Presence of skull fracture and scalp bruise or hematoma was noted. On dissection, the area of brain underneath the impact was examined for any injury (coup). Similarly, the area diametrically opposite to the site of impact was examined for presence of injury (contre-coup). Photographs were taken as necessary.All data were collected, compiled and subjected to suitable statistical analysis using appropriate methods. Results were presented using charts, tables, and diagrams as necessary.

Results:

During the study period, a total of 263 cases fulfilling the inclusion criteria were studied prospectively. Among 263 subjects studied, 37 (14%) were female and 226 (86%) were male. Majority of the subjects were in the age range of 21 to 30 years (20.91%) followed by the age range of 41 to 50 years (17.87%), 51 to 60 years (16.73%), 71 to 80 years (13.3%) , 31 to 40 years (12.92%), 61 to 70 years (8.36%), 11 to 20 years (7.60%) and 81 to 90 (2.28%). 65% cases were of road traffic accidents followed by cases of fall from height (19%) [Table 1]. Among 263 cases, 252 cases had coup injury, 238 cases had contre-coup injury and 227 cases had both. Among 263 total cases in the study population, majority(33.08%) had impact in the parieto-temporal region of the skull followed by occipital region (21.29%), fronto-parietal (17.87%) and frontal region (10.27%). Among 252 total cases with coup injury, the most common pattern of injury was subdural haemorrhage (SDH) only (seen in 156 cases) followed by presence of both SDH and subarachnoid haemorrhage (SAH) (seen in 66 cases). Brain contusion associated with meningeal bleed was present in 7.14% cases of coup injury. Extradural haemorrhage (EDH) associated with other types of meningeal bleed was seen in 5.95% cases of coup injury [Table 2]. Among 238 total cases with contre-coup injury, the most common pattern of injury was SDH only (seen in 137 cases) followed by presence of both SDH and SAH (seen in 55 cases). Brain contusion associated with meningeal bleed was present in 19.34% cases of contrecoup injury [Table 3]. Among 46 cases with contre-coup contusion, 20 cases i.e 43% included motorcycle riders (26% driving the motorcycle and 17% pillion riders).

Table 3. Showing distribution of cases with contre-coup injury according to type of injury.

Type of injury (n=238)	No. of cases	Percentage
SDH	137	57.56%
SDH, SAH	55	23.10%
SDH,SAH, Contusion	46	19.34%

Table 4. Showing distribution of sample according to state of motion of head during impact.

State of head during impact.	Number of cases
In motion	249
At rest	14
Total	263

Table 5. Showing distribution of cases with coup injury according to state of motion of head during impact.

State of head during impact.	Coup	No coup
At rest (n=14)	13	01
In motion (n=239	239	10

Table 6. Showing distribution of cases with contre-coup injury according to state of head during impact.

State of head during impact.	Contre-coup	No Contre-coup
At rest (n=14)	10 (71.42%)	4
In motion (n=249	228 (91.56%)	21

In 249 cases the head was in a state of motion at the time of impact whereas in 14 cases the head was at rest [Table 4]. Among 14 cases where the head was at rest during impact, 13 had coup injury. Among 249 cases where the head was in motion during impact, 239 had coup injury [Table 5]. Fisher's exact test was done with df=1 and specified significance level of 0.05, P value was 0.46 which is statistically not significant. Hence, we accept null hypothesis i.e there is no difference in rate of coup injury depending on state of motion of head during impact. Among 14 cases where the head was at rest during impact, 10 had contrecoup injury. Among 249 cases where the head was in motion during impact, 229 had contrecoup injury [Table 6]. Fisher's exact test was done with df=1 and specified significance level of 0.05, P value was 0.03 which is statistically significant. Hence, we reject null hypothesis i.e there is no difference in rate of contre-coup injury depending on state of head during impact. We accept alternate hypothesis and conclude that proportion of contre-coup injury is more in cases where head was in motion during impact.

Discussion:

In this study, a total of 263 cases were studied fulfilling the inclusion criteria, out of which, 226 cases were male (86%) and 37 were female. Amit M Patil et al.[2] in their study conducted from 1 November 2002 to 31 October 2004 at Topiwala National Medical College & BYL Nair Charitable Hospital, Mumbai found males were the most common victims. Similar findings were seen in other studies.[3-6] This can be easily explained since majority of drivers, pedestrians and construction workers working at heights are still males in our society. In 20 years and below age group, there were twenty cases. Maximum cases (55 cases) were found in the age group of 21-30 years age group. Similarly, Pathak A et al. in 2003 in their study[7] on autopsy finding of pattern of skull fractures and intra-cranial hemorrhages in cases of head trauma in department of Forensic Medicine, SMS Medial College, Jaipur found the age group 20-40 years covering the maximum number of incidences of head injury.

Frequency distribution of sample according to cause of injury shows maximum cases (172 in number) resulted from road traffic accidents followed by 51 cases resulting from fall from height. 12 cases were of railway accidents. 20 cases resulted from fall at home. In six cases, roof collapsed on the persons and two persons were hit on the head by a weapon. Accidents constitute a complex phenomenon of multiple causation. The etiological factors are classified into human and environmental factors.[8] The dominance of road traffic accidents can be explained by the lack of awareness and reluctance in obeying traffic rules among pedestrians, drivers and passengers. This makes the importance of formulating stringent traffic rules and strictly implementing them evident. Similarly, Pathak A et al. in their study[7] found the most common causative factor which was noted during the case study was the contribution of 66.84% (79 out of 120 cases) of the road traffic accidents followed by cases of fall from height covering 23.33% (28 out of 120 cases) and rest 10.83% included cases of assault and other traumas. Frequency distribution of cases with coup injury (n=252) according to type of injury (Table 2) shows SDH as the most common form of injury as seen in 156 cases. 66 cases had both SDH and SAH as coup injury. SDH, SAH and contusion of brain was present in 15 cases. EDH and SDH together was present in seven cases. Five cases had EDH, SDH and SAH. Only three cases had haemorrhage at all levels i.e EDH, SDH, SAH and contusion. Fifteen cases i.e 6% had EDH in total. Contusion of brain was seen in eighteen cases i.e. 7% cases.

Frequency distribution of cases with contre-coup injury (n=238) according to type of injury (Table 3) shows SDH as the most common form of injury as seen in 137 cases. 55 cases had both SDH and SAH as contre-coup injury. SDH, SAH and contusion of brain was present in 46 cases. Thus here, contusion of brain was seen in 46 cases i.e. 19% cases which is more than in case of coup injury.

Pathak A et al. in their study[7] also found SDH as the most common form of intracranial haemorrhage in 83.33% cases. Similar to our findings, they too observed EDH in 6.67% cases. Amit M Patil et alin their study [9] found a combination of SDH and SAH as the most common observation. SDH was the commonest form of intracranial haemorrhage in other studies also.[4,10-12]

Frequency distribution of sample according to state of head during motion shows during impact, in 249 cases the head and was in motion. In these 249 cases the moving head was brought to a sudden halt by the impact. The most common example here is cases of road traffic accidents where a pedestrian was hit by a car or motorcycle. In such circumstances, the primary impact was on the lower part of the body following which the person was thrown away by the force and the moving head then hit the road or some other structure. Similarly in cases of fall from height, the moving head is brought to a sudden halt as the person hits the ground. In 14 cases the head was at rest during impact. Such cases included incidents where the roof of the room collapsed on a person sitting or resting inside the room and also included two cases where a static person was hit on the head by a heavy blunt weapon. Since my sample included mostly cases of road traffic incidents and falls from height, most cases had the head in motion during impact.

Table 5 shows distribution of cases with coup injury according to state of motion of head during impact. It shows that out of 14 cases of head at rest during impact, 13 had coup injury while one case had no coup injury. Out of 249 cases where head was in motion during impact, 239 cases had coup injury and 10 cases had no coup injury. Fisher's exact test was done with degree of freedom=1 and specified significance level of 0.05. P value was 0.46 which is statistically not significant. Thus the null hypothesis had to be accepted i.e. there is no difference in rate of coup injury depending on state of head during impact.

Table 6 shows distribution of cases with contre-coup injury according to state of head during impact. It shows that out of 14 cases of head at rest during impact, 10 had contre-coup injury while four cases had no contre- coup injury. Out of 249 cases where head was in motion during impact, 228 cases had contre-coup injury and 21 cases had no contre-coup injury. Fisher's exact test was done with degree of freedom=1 and specified significance level of 0.05. P value was 0.03 which is statistically significant. Thus the null hypothesis had to be rejected. Alternate hypothesis was accepted i.e. proportion of contre-coup injury is more in cases where head was in motion during impact.

Conclusion:

It is to be kept in mind that this was purely an autopsy based study. Though antemortem factors were considered, yet a multi-disciplinary and multi-tier approach would have made it more accurate.

This study highlights the increasing incidence of road traffic accidents and also a significant number of fall from height cases. As seen in the study, in most of the cases, the head of the subject was in motion during impact which in turn increased the probability of the subject sustaining contrecoup injury. Brain contusion was seen more in cases of contrecoup injury than coup injury. Most of these cases included motorcyclists and pillion riders. Strict laws enforcing use of helmets will decrease number of such cases by reducing the chance and severity of head injury. Similarly, safety measures for construction workers need to be implemented.

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