Original Article

Cranial CT in the Evaluation of Coup and Countercoup Head Injuries

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Abstract

Objective: To describe the role of Cranial Computed Tomography (CT) in the evaluation of Coup and Countercoup head injuries with its outcome. **Study Design:** A comparative cross-sectional study. **Settings:** Radiology Department of PMC/Allied Hospital Faisalabad. **Duration:** 09 months, October 2012 to June 2013. **Sample Size:** 150 patients. **Materials and Methods:** The patients with coup and countercoup head injuries were studied and divided into two groups: Coup injuries (n=117), countercoup injuries (n =33) .The groups were comparable with respect to age, Glasgow Coma Scale (GCS) and outcome. Site of primary impact was determined by CT scan pattern. **Results:** The mortality rates in each group were compared with respect to age, GCS and CT pattern. Significance was calculated using Chi-Square test. There was a statistically significant difference in mortality between patients with coup injuries ($p \leq 0.005$) and patients with countercoup ($p \leq 0.001$). Mortality in patients aged less than 60 years and patients with GCS <8 was significantly lower in patients with countercoup. **Conclusion:** Presence of a countercoup component on CT scan may show a worse outcome in head injuries and may warrant closer monitoring and more aggressive management of these patients. **Keywords:** Coup, Countercoup, Glasgow Coma Scale, Head Injury.

INTRODUCTION

Head injury is a frequent cause of emergency attendance, accounting for approximately 3.4% of all presentations.[1] It is a major cause of morbidity world wide and one of the leading causes of death in the modern world among individuals under 45 years of age.[2,3] In developing countries accident rates in general and traumatic brain injury in particular are increasing as traffic increases besides other factors like industrialization, fall and ballistic trauma.

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Head injury refers to any damage to the scalp, skull, or brain. There are two general categories of head injuries: closed and penetrating. A closed injury is one in which the skull is not broken open. In penetrating injury, the skull is broken open. Closed head injury is the result of variety of mechanisms including motor vehicle and motor cycle accidents, fall from heights, assaults and pedestrians being hit by motor vehicles. Penetrating injury is most often due to gunshots but sometimes other types of blunt objects can violate the skull. Focal brain injuries are found in approximately one half of all the patients with severe brain injuries and are responsible for nearly two-thirds of the deaths associated with head injury.

Head injury is usually classified upon the patient's presenting level of consciousness according to GCS score as minor, moderate or severe head injury.[4] Patients with complicated minor head injury usually get good functional recovery although the post concussive symptoms may persist for some times.[5] Patients with severe head injury specially with GCS scores of 3 or 4 and those with age of more than 65 years, have a poor prognosis.[6]

Pattern of brain injuries are very vast and difficult, among which Coup and countercoup comprise a group of focal brain injuries. The coup injury may be caused when, during an impact, the skull is temporarily bent inward, and impacts the brain. When the skull bends inward, it may set the brain into motion, causing it to collide with the skull opposite side and resulting in a countercoup injury.[7]

Outcome after head injuries continues to be an evolving science, with various factors being implicated, as one of the studies also shows there is a considerable decline in mortality in severe traumatic head injury from 1970 to1990, at a rate of 9% per decade, but there is no significant progress since 1990.[8]

The outcome in the both components therefore expected to be different. It is increasingly evident that the pattern of structural brain injury as visualized by CT and the depth and duration of ischemia are also important factors. Although the pattern of injury on CT scan has been studied, outcome in relation to coup and countercoup injuries is not documented.

It has generally been accepted that the GCS and age of the patient are the two most important factors in prediction of the outcome. Modern trauma centers are increasing in its number worldwide to resolve this complicated problem but it still looks like to be unresolved epidemic of future.[9] This study will help to know pattern of coup and countercoup injuries which are very complicated and leads to increases number of deaths and result would not only be helpful to precisely delineate the type whether it is coup or countercoup but also in the management of patients to decrease morbidity.

MATERIALS AND METHODS

A comparative cross-sectional study included 150 patients having head injuries presented to Radiology Department of PMC/Allied Hospital, Faisalabad. All studies were performed with a helical CT scanner (G.E) and a protocol of contiguous axial 5-mm sections through the posterior fossa to the vertex. Performa was filled with respect to age, sex, mode of injury, & GCS. Following inclusion & exclusion criteria used.

Inclusion Criteria

- Coup injuries (Fracture of calvarium, Underlying hematoma or contusion. Subgaleal hematoma,)
- Countercoup injuries. (Fracture of calvarium, Underlying hematoma or contusion.)
- Subgaleal hematoma

Exclusion Criteria

- Patients with systemic injuries
- Polytrauma patients.
- Previous head injuries.

Out of 150 patients (N=150) the injuries were classified into Two groups: Coup injuries (n=117), countercoup injuries (n=33). Outcome measured in this study was mortality rate. The groups were also compared with respect of age and GCS. Chi-square test used for mortality rates compared across the injuries and then correlated with the GCS & age and conclusions were based upon on the p-value and p-value<0.05considered as significant.

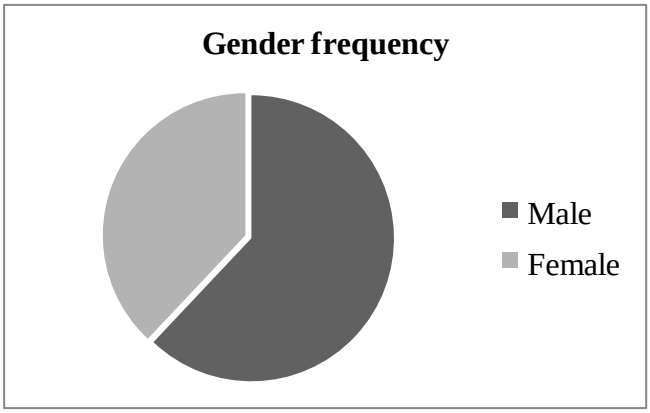
GCS was classified into mild, moderate and severe. Mild: 13-15, Moderate: 9-12 and Severe: 3-8

RESULTS

The age of the patients ranged from 05 months to 65 years with an average age of 20.5 years. Males

were 93(62%) and females 57(38 %) as shown in pie chart.

Figure-1
Gender frequency of total patients N=150



There was no significant difference amongst the two groups with respect to average age, but patients with coup injuries were younger and predominantly observed in male.
Fall from height was the commonest mode of injury in age less than 20 years (50%) and road traffic accident being the most common among females with age ranging between 20- 55 years (44%), followed by assault with age 21-40 years (6%).

Figure-2
Relation of total number of patients & gender with cause of head injuries

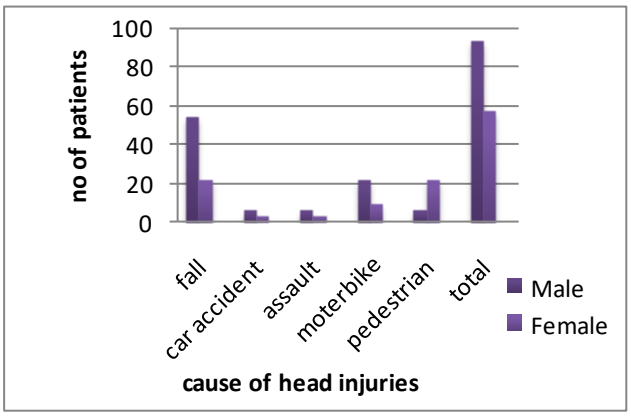
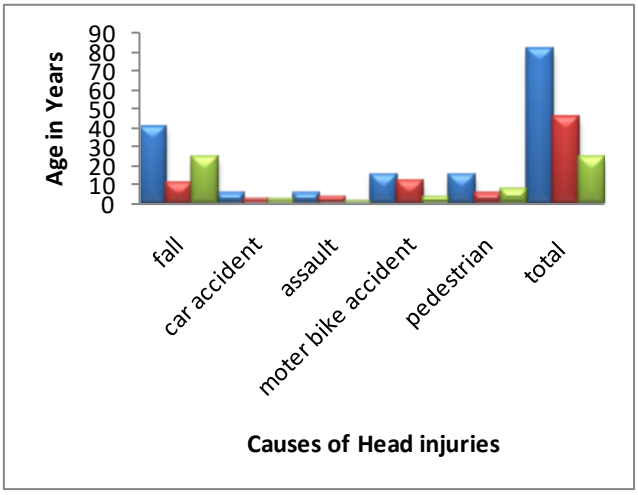


Figure-3
Relation of total number of patients and their age with cause of head injuries



The mean GCS of the entire study population was 09, and there was no difference of GCS in two groups.
Among the total patients, (78%) had coup injury and (22%) had significant countercoup injuries.

Table-1
Shows the pattern of head injuries

Type of lesion	n	Percentage
I. Coup ((n = 117)		
Fracture with SDH	11	9%
Depressed fracture with contusion	40	34%
Linear fracture with EDH	20	17%
EDH with contusion	12	10.2%
EDH with SDH + contusion	05	4.2%
Acute SDH	15	12.8%
Acute SDH +Contusion	07	5.9%
Contusion		
Subarachnoid hemorrhage +contusion	07	5.9%
Total	117	78%
II. Countercoup injuries (n =33)		
Acute SDH	10	30.4%
Contusions	14	42.4%
Acute SDH with contusion	09	27.2%
Total	33	22%

The most common coup injury was depressed fracture with contusion (n=40) followed by linear fracture with extradural hematoma (n=20).
Patients with contusions distant from the site of primary impact were the dominant group (n =14).

Table -2
Outcome of coup and countercoup injuries

Outcome	Coup	Countercoup injuries	P-value
Improved	85(72.6%)	19(57.5%)	
Same	15(12.8%)	05(15.5%)	
Dead	17(14.5%)	09(27.2%)	≤0.001

According to the finding of above mentioned table, 72.6% patients were improved with coup injuries and had a significantly lower mortality (p≤ 0.005). Countercoup had increased the mortality rate, (p≤0.001) which is significant.

Table-3
Shows mortality in relation to GCS

Mortality	Coup	Countercoup injuries	P value
3-8	20/50(40%)	8/21(38%)	NS
9-12	5/34(14.7%)	3/8(37.5%)	≤0.04
13-15	1/33(3%)	1/4 (24%)	≤0.02

NS* Non significant

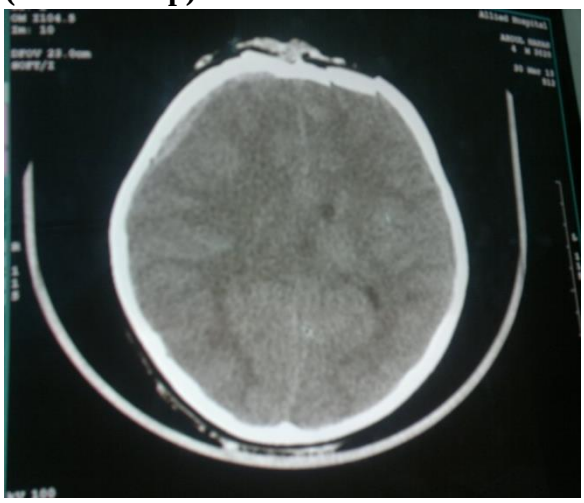
There was no significant difference in mortality in two groups for severe head injury in relation to GCS but significant difference observed in injury having mild to moderate in countercoup types of injuries.

Table-4
Mortality in relation to age groups

Age(yrs)	Coup	Countercoup injuries	P value
Up to 40	12/78(14.38%)	3/7(42.8%)	≤ 0.001
41 to 60	4/28(14.2%)	8/21(38%)	≤0.001
above 60	6/11(54.45%)	3/5(60%)	NS

NS* Non significant

Figure-4
Shows (coup) left frontal depressed fracture with right parietal extradural hematoma (countercoup)



DISCUSSION

Accurate and in time diagnosis of brain lesions in acute head injury is of great importance because of the high mortality rate. An early diagnosis and management will significantly reduce the complications. Upon the advent of CT scan in the late 70s, as a noninvasive and easily accessible method, the outcome of patients has been improved greatly.[3]

Presently CT scan is the 1st line modality for evaluation of patients with acute head injury because it demonstrates fractures along with intra and extra-axial lesions which may need immediate surgical intervention. [10] The GCS is taken as standard for head injury to make an early and accurate prediction of outcome.

However, as our study shows it is not an absolute predictor as there are patients with poor scores who may improve as patients with good scores who may not. This suggests the participation of other factors in influencing the outcome after head injury. Marshall et al have related outcome with respect to CT findings in patients with head injuries. According to him other factor like raised

intracranial pressure also have been shown to be associated with a poor prognosis.[11]

Only few studies are available to deal with the role of coup versus countercoup injuries in influencing the outcome. In our study the GCS and age were compared in two groups, and most of patients having coup injuries were in younger age groups.

This study specifically evaluated patients and their injury patterns as predictor of outcome. Older age along with GCS less than 8 was found to be a significant predictor of bad prognosis. This finding is consistent with Jeret et al.[12] who prospectively studied patients with non penetrating head trauma and a GCS score of 15 and also found increasing age to be significantly associated with an abnormal CT scan. Similarly, in another study of 1429 patients, Haydel et al[13] suggested age >60 years as one of the criteria that may be used to obtain a CT scan in patients with head injury. In our study age is also having significant poor prognostic value but became more worsen when associated with countercoup head injuries independent of age limit.

Jayakumar et al[14] found mortality rate of 9.6% of the total 650 patients having countercoup injuries. That study comprising cases of only countercoup head injuries and mortality rate was 41% in less than 40 years of age and 67% in patients more than 40 years of age. Our study is comparable to the findings of Jayakumar et al. however; in our study countercoup injuries were 22% with mortality rate of 42.8% in patients less than 40 years and 38% in patients more than 40 years of age.

The gender disparity was also another significant phenomena observed. This adds to the current ongoing debate about the role of gender in trauma outcomes. Previous studies have shown that women have significantly lower mortality rates and lesser in numbers than men of similar age after traumatic injury [15].

In our study, females had less head injuries and low mortality rate because they are less exposed to external environment as compared to males due to cultural restraints in our society[16].

Patients with history of fall were more likely to have positive CT scan finding. Similarly, Smits et al[17] reported that history of fall from any elevation is one of the minor criteria for obtaining a head CT scan in patients with mild head injury. This is also same in our study.

Mortality rates varied significantly among the two groups of coup and countercoup injuries. However the mortality is higher in spite of the nature of injury when the age of patient is more than 60 years with GCS less than 8. The mortality rate in our study is consistent with Seelig et al [20] which was more in subdural hematoma.

Lobato et al [18] found the highest mortality (58%) for patients with single factor of bilateral contusions whereas; in our study patients with subdural hematoma as well as bilateral contusions had a mortality of 35%. In contrast to the study by Kotwica et al [19], patients with acute subdural hematomas with associated contusions had a better outcome as compared to acute subdural hematomas alone. This is also contrary to the findings of Seelig et al [20] who found no difference in outcome for patients with or without associated contusions.

Our study also shows poor prognosis in patients with countercoup injuries as compared to those with only coup injuries, because farther the spread of the shock waves through the brain, more the damage and worse the outcome.

CONCLUSION

Study shows that there is a definite role of CT scan in the evaluation of coup and countercoup head injuries and its outcome especially in relation with GCS and age groups. The patients with more than 60 years of age with GCS <8, and presence

of countercoup head injury component are associated with a poor outcome.

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