

# Radiological Appraisal of Moderate to Severe Head Injury – Medicolegal Implications

Ghulam Mustafa Yousfani, Saba Sohail, Mohammad Umar Memon

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## ABSTRACT

**OBJECTIVE:** To compare the diagnosis of X-ray and CT scan of skull in assigning the correct kind of moderate to severe head injury (Shajjah) for medicolegal (ML) certification, and also the clinical severity of head injury against the medicolegal severity.

**STUDY DESIGN:** Comparative study.

**DURATION AND SETTING:** Medicolegal Section of Accidents and Emergency Department, Civil Hospital Karachi (CHK) and Radiology Department, Dow University of Health Sciences CHK, From June 2008 to May 2009.

**METHODS:** One hundred cases of moderate to severe head injury based on Glasgow Coma score (GCS) of 12 or less, with fractured skull reported for medicolegal certification were included. Those with mild injury (GCS 12 or greater), without fracture of skull, with additional face injury, or non medicolegal cases were excluded. Plain X-rays and CT scan of skull and brain were performed in every case. Radiological findings, GCS, and demographics were noted. Shajjah injury types were assigned according to Qisas and Diyat Act terms. Findings of both modalities were compared for medicolegal and clinical severity of injuries and expressed in numbers and percentages.

**RESULTS:** There were 54 cases of moderate and 46 cases of severe head injury. As against CT scan, plain X rays failed to reveal any injury in 21 cases later diagnosed on CT scan Hashimah (n=4), Munaqillah (n=04), Ammah (09) and Damighah (n=04) hurts. Additionally, X rays under diagnosed 60 cases of Shajjah hurts. Nine cases of Shajjah-i-Damighah were similarly diagnosed on X-ray and CT scan. The mean GCS score was  $11.3 \pm 4.1$  in Hashimah,  $9.4 \pm 3.1$  in Munaqillah,  $7.8 \pm 4.1$  in Ammah and  $8.6 \pm 3.3$  in Damighah hurt.

**CONCLUSION:** In comparison with plain X rays, CT scan had superior performance in correctly assigning the ML grade of head injury in the moderate to severely injured case. The cases with higher clinical severity (lower GCS core) did not necessarily have a higher medicolegal grade of injury.

**KEY WORDS:** Islamic forensic terms, CT scan, plain X-rays, Glasgow Coma scale, Qisas and Diyat Act.

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## INTRODUCTION

Head injury is a major cause of morbidity worldwide.<sup>1</sup> The annual rate of head injuries in Pakistan is 81 per 100,000 with a mortality rate of 15%.<sup>2</sup>

Head is the uncovered, most prominent body part encasing the vital most organ i.e. the brain, and rather vulnerable to violence particularly of criminal nature. In forensic context the perpetrator of such an injury is criminally responsible and liable for punishment thus determination of the kind of hurt is obligatory for medicolegal certification of the injured.

The currently practiced Qisas and Diyat Act classify head injuries into six types depending upon the depth and severity. These range from superficial soft tissue injury without exposing the bone (Shajjah-i-Khafifah), exposing the bone without fracture (Shajjah-i-Mudihah), fracture without dislocation (Shajjah-i-Hashimah). Fracture with dislocation (Shajjah-i-Munaqillah) fracture touching the dural membrane/

causing hemorrhage (Shajjah-i-Ammah) and fracture rupturing the membranes (Shajjah-i-Damighah); these represent increasing seriousness of injury sustained by the victim and thus the severity of punishment for the offender.<sup>3</sup>

The use of radiology is invaluable in the dispensation of medicolegal work where fractures of skeleton are suspected. Medicolegal officers (MLOs) in local setup usually rely only on skull radiography as screening tool for suspected trauma to skull. Although computed tomography (CT) scan has been universally accepted as the imaging modality of choice after head trauma and also as the only source of morphological evidence;<sup>4, 5</sup> however its use has not commonly employed in medicolegal work.

The peculiarity of Pakistani law requires precise description of lesion which is usually not possible on plain radiography alone. There is no available published evidence for this purpose. No such study has

been carried out in Pakistan; there are no equivalent parameters in the legal enactment of other regional, muslim or non-muslim countries. So this provided a rationale to determine as to which modality i.e. X-ray or CT scan is providing better evidence of morphological injury for precise medicolegal certification. More severe injuries are also supposed to have more morphological damage. The less the GCS score, the greater is the expected morphological damage or injury severity. However this is not usually observed in clinical practice particularly in medicolegal. Where, sometimes injury is feigned and not radiologically visible. The facts of lacking evidence for the correct modality for medicolegal certification of head injury and comparison of clinically severe with radiologically severe injury provided the rationale for this study.

The aim of this study was to compare the diagnosis of X-ray and CT scan of skull in assigning the correct kind of moderate to severe head injury (Shajjah=Sh) for medicolegal certification, and also the clinical severity of head injury against the medicolegal severity of hurt.

#### METHODS

This comparative study was carried out at the medicolegal section of Accident and Emergency Department, and Radiology Department of Civil Hospital Karachi / Dow University of Health Sciences. The study period spanned from June 2008 to May 2009.

Medicolegal cases were defined as cases of head injury referred by Police Department or Police Surgeon, Karachi for medicolegal certification. Clinical severity was determined by Glasgow Coma Scale (GCS) score. <sup>6</sup> Moderate injuries were defined as those with GCS score of 9-12 and severe injuries were defined as those GCS of 8 or less.

Inclusion criteria were medicolegal cases of moderate to severe head injuries irrespective of age and gender with history of assault. Sampling technique used was purposive, non-probability technique.

Exclusion criteria were non-medicolegal cases of head injury caused by falls, and medicolegal cases with diffuse axonal injury. The latter requires MRI for diagnosis and hence was not the subject of study. Skull radiography was done on 500 mA X-ray machine and Tounes and lateral views were obtained. CT scan was done with 1-1.5 cm thick axial sections without giving intravenous contrast. Head copy and console images were read at brain and bone settings.

Patient demographics, GCS score, medicolegal kind of injury on X-rays as well as CT scan were noted. Being an observational study, descriptive statistics

were used for determining the measures of central tendency and dispersion such as mean age and GCS score with standard deviation and range; and frequency and proportion of the gender, kinds of hurt and positive and negative cases of each imaging modality.

#### RESULTS

Out of the total 100 cases 90% were males and 10% were females. The mean age was  $28.97 \pm 15.95$  years, ranging from one (01) to seventy-five (75) years. Fifty-three (53%) were between 18-40 years. Frequency distribution of various kinds of hurts is given in (Tables I). The clinical type and GCS score for each kind of hurt is also given in (Table I).

In 21 cases, X-rays did not show any injury despite a clinically moderate to severe injury. CT scan in those 21 cases showed 04 fractures without dislocation (Shajjah-i-Hashimah) 04 fractures with dislocation (Shajjah-i-Munaqillah), nine fractures with extradural haemorrhage (Shajjah-i-Ammah) and 4 fractures of skull with ruptured membranes (Shajjah-i-Damighah). Similarly there were disparities between X-ray diagnoses of fractures without dislocation where only six cases could be confirmed as such-the rest being different. Likewise 05 out of 19 cases of fracture of skull with dislocation seen on X-rays could be confirmed as same on CT – the rest being different again. Their details are given in Table II. All the 09 cases diagnosed on X-ray as Shajjah-i-Damighah i.e. fracture skull with ruptured membranes were confirmed as such on CT scan. None of the 48 cases of Shajjah-i-Ammah could be diagnosed on X-ray. All were diagnosed on CT scan.

**TABLE: I GCS SCORES IN DIFFERENT HURTS SHOWING THE CLINICAL AND MEDICOLEGAL SEVERITY (n=100)**

Medicolegal Hurt	Clinical Severity			
	Moderate (n=54)	Severe (n=46)	Mean $\pm$ SD GCS	Range
Hashimah (n=10)	06	04	11.3 $\pm$ 4.1	5-12
Munaqillah (n=12)	08	04	9.4 $\pm$ 3.1	4-12
Ammah (n=48)	25	23	7.8 $\pm$ 4.1	3-12
Damighah (n=30)	15	15	8.6 $\pm$ 3.3	3-12

TABLE: II COMPARISON OF X RAY AND CT DIAGNOSIS (n = 100)

Diagnosis By X-Ray	Diagnosis by CT Scan				
	Shajjah-i-Hashimah	Shajjah-i-Munaqillah	Shajjah-i-Ammah	Shajjah-i-Damighah	Total
No traumatic lesion	4	4	9	4	21
Shajjah-i-Hashimah	6	3	29	13	51
Shajjah-i-Munaqillah	-	5	10	4	19
Shajjah-i-Damighah	-	-	-	9	9
<b>Total</b>	<b>10</b>	<b>12</b>	<b>48</b>	<b>30</b>	<b>100</b>

## DISCUSSION

Several studies have been conducted on head injuries from medical or neurosurgical view point as well as forensic. However no such study has been conducted in the perspective of the local prevailing Islamized laws of Qisas and Diyat Act that may show the utility of the imaging modalities in correctly assigning the Shajjah injury grades. Thus it can act as an evidence-based guideline for medicolegal officers who have to certify injuries for judicial processing.

The group under study was that of predominantly young males with moderate to severe injury as evidenced by their lower GCS scores. The gender and age epidemiology in forensic context is well understood and reported.<sup>7-10</sup> This is in keeping with the general life-styles, occupational and social interaction.<sup>11</sup>

Newer evidence has been obtained for the imaging modality that should be used in our settings. X rays could not diagnose fractured skull with extradural haemorrhage and altogether missed 21% cases of fractures of any kind and severity. Khan and colleagues have established that normal X ray of skull does not rule out extradural haemorrhage (EDH),<sup>12</sup> which is an important criterion for diagnosing Shajjah-i-Ammah hurt. The Consequent punishment is substantially different hence the fact become medicolegally very important. Reed *et al* and Taheri *et al* have also concluded the lesser information and value of skull X-rays which could even be abandoned in favor of CT scanning.<sup>13, 14</sup> The present study also confirms the same findings.

All CT scans however provided morphological evidence as per Qisas and Diyat Act kinds of hurt. All cases of extradural haemorrhage with fracture (Shajjah-i-Ammah) were determined on CT scanning other researchers have also emphasized that CT scanning is the imaging modality of choice in revealing not only the bony injury but also the associated haemorrhage and membrane ruptures.<sup>15,16</sup> In this study, the frequency of Ammah hurts was high-

est i.e. 48%. This suggests EDH to be the most common associated finding in a fractured skull particularly when found in a case with GCS less than 12. As shown by the associated GCS score, it was the lowest in this type of injuries i.e. mean value of 7.8 ranging from 3-12. This indicated a clinically severe injury out of proportion of the morphological injury seen on X-rays alone. Hence GCS determination can also be a guide for further imaging investigations, as it has shown to be a reliable tool for brain injury.<sup>17</sup>

Important to note are the facts that X-rays failed to correctly diagnose the medicolegal kind of hurt in an overwhelming majority of cases in the moderate to severely injured patient regarding skull. Only the minor or the most grievous degrees of hurt were correctly diagnosed on plain X-rays. These included 06 out of 10 cases of Shajjah-i-Hashimah and 09 out of 30 cases of Shajjah-i-Damighah. The latter is diagnosed by the presence of air in the cranial cavity and air is clearly visible in both radiography and CT scanning. The former is a lucency that can be confused with sutural or meningeal markings on radiography alone.<sup>18</sup>

## CONCLUSION

In comparison with plain X-rays, CT scan had superior performance in correctly assigning the ML grade of head injury in the moderate to severely injured case. The cases with higher clinical severity (lower GCS score) did not necessarily have a higher medicolegal grade of injury.

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*AUTHOR AFFILIATION:*

**Dr. Ghulam Mustafa Yousfani** (*Corresponding Author*)

Department of Forensic Medicine  
Dow University Health Sciences  
Karachi, Sindh-Pakistan.  
Email: drgmy@hotmail.com

**Dr. Saba Sohail**

Associate Professor, Department of Radiology  
Dow University Health Sciences  
Karachi, Sindh-Pakistan.

**Prof. Mohammad Umar Memon**

Chairman, Department of Forensic Medicine  
Dow University Health Sciences  
Karachi, Sindh-Pakistan.