3-2004

# An audit of head trauma care and mortality

Arshad A. Siddiqui
*Aga Khan University*

Hasnain Zafar
*Aga Khan University*, hasnain.zafar@aku.edu

S H. Bashir
*Aga Khan University*

ORIGINAL ARTICLE

# AN AUDIT OF HEAD TRAUMA CARE AND MORTALITY

Arshad A. Siddiqui, Hasnain Zafar* and Saad H. Bashir

## ABSTRACT

**Objective:** To analyze the factors contributing to deaths from head trauma by using standardized assessment parameters and to provide a peer-review of head injury deaths with focus on identifying deficiencies and analyzing contributory factors.

**Design:** Descriptive study.

**Place and Duration of Study:** The study was carried out at the Emergency, Aga Khan University Hospital during January 1998 to December 1999.

**Subjects and Method:** One hundred and three patients above the age of 15 years presenting alive to the Aga Khan University Hospital (AKUH) emergency with head injury were included in this study. Identified deaths data was reviewed by the Hospital Trauma Peer Review Committee and consensus arrived at for categorization of deaths. The potential deficiencies in care were identified and final recommendations made. The data was computed on CDC Trauma Registry (V 3.0) and SPSS (V 8.0).

**Results:** Mean age was 31.9 years (n=103) with predominant male population (4:1). Severe head injury (GCS≤8) accounted for 21.3 % (n=22) of all cases with a total number of deaths being 12.6 % (n=13). Deaths were categorized preventable in 3 cases with non-preventable and potentially preventable in 4 and 6 cases respectively. Road traffic accidents were the predominant mechanism (n=8) in all deaths (n=13). The time interval in relation to mortality was biphasic, most deaths occuring either within 24 hours or between 3-7 days of injury. Inappropriate pre-hospital treatment, pre-hospital delays and inappropriate mode of transportation without inter-hospital communication were the process-related defects in pre-hospital care with major determinant of deaths outside AKUH (n=5). Prolonged emergency stay, delayed intensive care availability were the process-related deficiencies whereas inappropriate initial resuscitation, inappropriate initial head injury management were provider-related deficiencies in in-hospital care.

**Conclusion:** Transfer of inappropriately managed patients, lapses in inter-hospital communications, delayed transfers were identified as the major pre-hospital factors whereas lack of ICU beds, portable ventilators in emergency room, delays in CT scan facilities were the deficiencies in the hospital services. Opportunities for improvement in head trauma care are needed to focus on initial resuscitation and appropriate surgical management.

**KEY WORDS:** *Care. Head trauma. Mortality. Peer review.*

## INTRODUCTION

Pakistan with a population of 135 million is one of the ten most densely populated countries in the world.[1] Head trauma is acknowledged as the leading cause of death and disability affecting the group of population in its most productive years of life.[1,2] The second and third decades of life are the most adventurous age group carrying higher risk of head injury in the United States.[3,4] It not only brings down the level of physical and mental health of community, especially among the younger age groups, but is also a cause of increased socioeconomic burden on society.

The estimated annual rate of head injury in United States is 200 per 100,000 with a mortality rate of 13-14 per 100,000 whereas the calculated annual rate of head injury patients in Pakistan is 81 per 100,000 with a mortality rate of 15 percent.[1,2] In United States, head injury occurs every 15 seconds, and a patient dies of head injury every 12 minutes.[5] Similarly, approximately 50% of all trauma deaths are associated with head injury, and more than 60% of vehicular trauma deaths are due to head trauma.[5]

Epidemiological data on deaths due to head injury in Pakistan is scarce. The focus of this study was to evaluate the head trauma care with a peer review of the head injury deaths using standardized assessment parameters in a university teaching hospital.

## PATIENTS AND METHODS

Data of 103 head injury patients were retrieved from the Hospital Trauma Registry over a period of two years. It included all the patients of age 15 years and above, having head injury (both isolated and with poly-trauma) presenting alive and included emergency room deaths. Pediatric head injuries (≤ 14 years) including patients reaching dead on arrival in emergency room were excluded. Variables were documented on a pre-designed trauma form on the arrival of patient in emergency room. The pre-hospital data included time of injury, mechanism of injury, mode of admission, mode of transportation and primary hospital resuscitation in patients transferred from another hospital. Emergency room data included hemodynamic parameters, information on resuscitation, diagnostic work-up in emergency room and emergency room stay time.

Department of Neurosurgery, The Aga Khan University Hospital, Karachi.
*Department of General Surgery, The Aga Khan University Hospital, Karachi.

**Correspondence:** Dr. Arshad A. Siddiqui, Chief Resident Neurosurgery, Department of Surgery, The Aga Khan University, Stadium Road, P.O. Box 3500, Karachi, Pakistan. E-mail: doc4brains@yahoo.com

Received September 01, 2003; accepted February 23, 2004.

Definitive treatment data comprising of the details of operative intervention, diagnostic procedures, and intensive care stay till discharge death and time to definitive treatment, were recorded. Time to definite treatment was calculated in all the patients, as the sum of the time from injury to presentation at the emergency room of the Aga Khan University Hospital and time to definitive care from presentation in emergency room.

The data was subjected to a peer review. For this purpose, a standard narrative summary of each head trauma death was prepared and circulated to the members of a peer review committee consisting of neurosurgeon, trauma surgeon, general surgeon, orthopedic surgeon, accident and emergency physician and anesthetist. Each member was provided with standardized guidelines for categorization of deaths (Table I). The

**Table I**: Guidelines for peer review panel.

| Category | Guidelines |
|---|---|
| Non preventable | 1. Injuries and sequelae non-survivable with optimal management.<br>2. Evaluation and management appropriate to ATLS guidelines.<br>3. Suspect care does not effect classification of death but is treated as morbidity. |
| Potentially preventable | 1. Injuries or sequelae severe but survivable.<br>2. Evaluation and management generally appropriate.<br>3. Error(s) in care directly or indirectly implicated in patient's death. |
| Preventable | 1. Injuries or sequelae considered survivable.<br>2. Evaluation and management suspect.<br>3. Error(s) directly or indirectly caused patients death |

committee was kept blind to both the identity of patient and the attending physician. Each member reviewed all the deaths and made a judgment based on his clinical experience and objective data categorizing each death as preventable, potentially preventable and non-preventable. Finally each death was discussed in a combined meeting of trauma peer review committee to arrive at a final consensual decision regarding the classification of each death. Potential deficiencies were identified and recommendations for improvement were proposed. Data was computed and analyzed on SPSS (Version-8) software.

## Results

The mean age of the patients was 31.97 (15-75) years with preponderance of male population in a ratio of 4:1. About 1/3 (21.3%) of the patients had severe head injury along with 16 patients (15.1%) with moderate head injury and 65 patients (63.1%) with mild head injury. Road traffic accidents was the mechanism of injury involved in more than two-third of the cases (n=79) whereas gunshots injury (n=12) and fall (n=6) came in subsequent order. Among the patients who had road traffic accidents, the commonest patterns of head trauma were vehicle-to-vehicle (n=18), vehicle-to-pedestrian (n=17) and motorbike (n=15). But certain injury like fall from running vehicle or train (n=4) was also present which was peculiar to our country and in subcontinent.

Seventy-seven (74.7 %) patients were sent home with a good outcome while 12 patients (11.3 %) were transferred to other hospitals mainly because of unavailability of ventilatory support required for these patients. One patient went home against medical advice. The overall mortality was 12.6 % (n=13).

Thirteen patients (n=13) who died in our study were then subjected to peer-review analysis. On the basis of consensus 3 deaths were categorized as preventable, 4 were non-preventable and 6 were potentially preventable. The head trauma deaths in the hospital on the time-line from time of injury to death were bimodal in distribution as in Figure 1. In the non-preventable death category (n=4), mean age of the patients

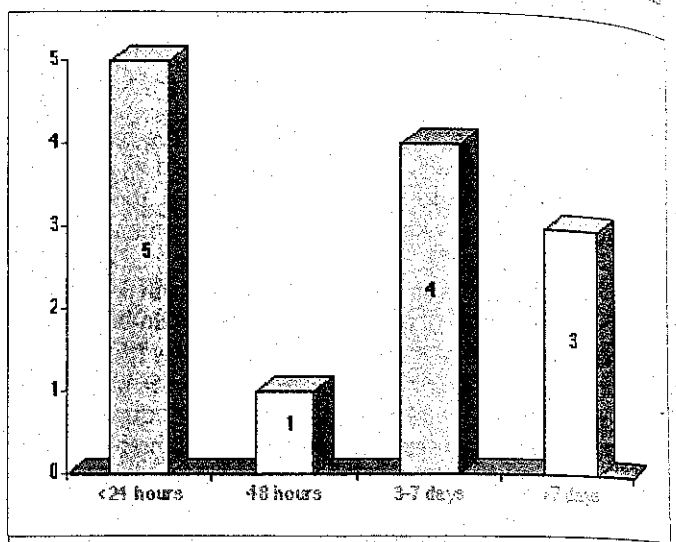


**Figure 1:** Biphasic timing of mortality from injury to death during the hospital stay.

**Table II**: Summary of individual patient in non-preventable death category.

| Patients | Diagnosis | Surgery | Death category (potential deficiencies) |
|---|---|---|---|
| 21 yrs/F | Brain contusions (poly-trauma) | No | Inappropriate admission in neurosurgery. |
| 25 yrs/M | Skull fractures + brain matter oozing out | No | Inappropriate transfer from primary center. |
| 25 yrs/M | Gunshot injury head + neck | No | Prolonged stay in ER (101min ICU unavailability). |
| 25 yrs/M | Gunshot injury head + abdomen | Yes | Inappropriate transfer from primary center. |

**Table III**: Summary of patients in preventable death category.

| Patients | Diagnosis | Surgery | Complication | Death category (potential deficiencies) |
|---|---|---|---|---|
| 45 yrs/M | Extra dural hematoma | Yes | None | Inappropriate transfer leading to delayed Neurosurgical intervention. |
| 36 yrs/M | Acute subdural hematoma | No | Chest infections (ARDS) | Prolonged ER stay 360 min (CT Scan breakdown + ICU unavailability). |
| 44 yrs/M | Bifrontal contusions | Yes | None | Inappropriate conservative management delaying surgical intervention. |

was 24 years with male to female ratio of 3:1. The mechanism of injury in 2 patients was road traffic accident while in the other 2 patients it was gunshot head injury. All the patients had severe head injury with a GCS of <8 (Table II). In the preventable death category (n=3), mean age of the patients was 37.6 (36-45) years, including all the male patients. Two patients had road traffic accident and one had fall from height. Two patients had severe head injury (GCS <8) and one had moderate head injury (Table III). In the potentially preventable category (n=6), mean age of the patients was 45.3(19-60) years including all the male patients. Five patients had severe head injury (GCS<8) and one had moderate head injury (GCS 9-12). Four patients had head trauma due to road traffic accident and 2 patients had fall from height. Five patients had isolated head injury and one patient had poly trauma including abdominal, orthopedic and head trauma (Table IV).

The data received from final consensus of peer review committee for deficiencies in care was analyzed to categorize it in two setting namely pre-hospital and in-hospital.

In the pre-hospital setting (Table V), the peer review committee concluded that out of all head trauma deaths (n=13), 5 patients had been found to be inappropriately transferred from the primary center with a total pre-hospital delay before reaching the AKUH (the duration between the time of injury to the arrival in AKUH emergency room) was 229 minutes (mean time). In the in-hospital settings, the results were arranged in two groups, first, the deficiencies in the capacity of the provider (Table VI); second those related to the system or the process.

**Table IV:** Summary of the cases in the potentially preventable category.

| Patients | Diagnosis | Surgery | Complication | Death category (potential deficiencies) |
|---|---|---|---|---|
| 19 yrs/M | Acute subdural hematoma | No | None | Inappropriate surgical decision for "no intervention" |
| 30 yrs/M | Depressed vertex Skull fractures | Yes | DIC/ Per-op bleeding | Inappropriate surgical technique/decision "sagittal sinus tear" |
| 58 yrs/M | Contusions+ Skull base fractures | Yes | DIC | Prolonged ER stay (CT scan breakdown) |
| 55 yrs/M | Skull base fracture+pneum--ocranium | Yes | None | Prolonged ER stay (No ICU/Ventilator) Hand-bagging for 6 hrs |
| 60 yrs/M | Polytrauma + severe head injury | No | Shock | Inappropriate resuscitation (Mannitol + no abdominal evaluation) |
| 55 yrs/M | Blunt trauma head | No | Shock | Prolonged pre-hospital delay |

**Table V:** Process or system related deficiencies in head trauma care (n=13 (Pre-Hospital Factors).

| Process defect | Number of patients |
|---|---|
| Inappropriate transfer | 5 |
| Inappropriate mode of transportation | 10 |
| Pre-hospital delay | Mean=229 minutes |
| No inter-hospital communication | 10 |
| Inappropriate pre-hospital treatment | 5 |

**Table VI:** Provider-related deficiencies in care (n=13) (In-Hospital).

| Process defect | Number of patients |
|---|---|
| Inappropriate initial resuscitation | 3 |
| Inappropriate head injury management | 6 |
| Deficient documentation | 10 |
| Inappropriate/delayed surgery | 4 |

# DISCUSSION

The term "peer review" has a long and established historical background and it was originally used for the knowledge provided by physicians from their own experience, reviewed by other physicians of the same credential to be published and applicable in the medical practice.[6,7] Perhaps the first documented description of a peer review is in a book called Ethics of the Physician by Ishap bin Ali Al Rahwi (CE 854-931) of Al Raha Syria.[6,7] It is not surprising that surgeons were the first group of physicians to publish their mortality results or disease categories.[8,9] When a surgeon intervenes in a disease process, the results are immediate and definitive.[8]

Peer review of trauma deaths is the process of performance review by a multidisciplinary panel with similar credentials,[10-12] which identifies deficiencies at the level of care provider and in the process of care. The impact of the peer review process on outcome of trauma care can be significant especially if identified deficiencies are considered as opportunities for improvement. It allows comparison between services both nationally and internationally and adjustments for case mix can be made using a matching score. Repeated reviews of institutional mortality allow trend analysis, which indicates whether the avoidable death rate is increasing or decreasing.[13] In 1988, Deane *et al.*[14] reported a potentially avoidable neurosurgical mortality of 8% and a non-neurosurgical mortality of 63%. Raja *et al.* provided the only available comparable data in Pakistan on head injuries in the literature.[1]

Seventy-nine percent (n=82) of patients in our study were male which reflects the male preponderance for exposure to head trauma as compared to their female counterparts. In China, data collected from six cities revealed head trauma in 62.4% of male individuals.[15] Despite the differences in the social norms, the findings are consistent with the international data.[16] Road traffic accidents are the commonest cause of head injuries affecting 79 patients (76.6%) as compared to 21% patients in a study from Denmark and 68.7 % from Taiwan.[17,18] In this study, 21.5% of all patients involved in the road traffic accidents were pedestrians hit by vehicle and it was the most frequent cause of head injury compared to vehicle crashes in other studies. It also reflected an inappropriately managed road traffic system in a third world country like ours. Fall was another important cause of head trauma observed in our study accounting for 9% of all study patients.

Twenty-one percent of patients in this study had severe head injury (GCS <8) while majority of patients had minor (63%) or moderate head injury (15.1%). So our hospital received less number of severely head injured patients and few patients (n=8) had been sent to other hospital because of limited number of ventilator available for the severely head injured requiring ventilatory support.

Thirteen patients (12.6%) died are less from that described by Raja *et al* in their study (15%) from the different centers working in government sectors.[1,2] The mortality is much lower in the developed countries such as 11.5 per 100,000 in Germany, 6.3 per 100,000 in People's Republic of China and 5.2 per 100,000 in the United States.[5,15,19]

Comparable peer review analyses from Singapore, New Zealand, Australia, and the United States were kept as standard.[20-25] Time from injury to death was biphasic (Figure 1) showing that most of the deaths occurred either within 24 hours or later between 3-7 days after the head injury. The likely possibility of early deaths within 24 hours were due to hypoxia and hypotension in the pre-hospital period and later deaths could be due to multi-organ failures and nosocomial infections.

All the non-preventable deaths (30.7% of all head trauma deaths) had severe head injury (GCS<8) and nature of injury was incompatible with the survival, even at the time of arrival in the emergency room. In potentially preventable category (46.1% of all head injury deaths), majority of patients (n=5) had severe head injury and one patient had moderate head injury. The deficiency were found in the in-hospital care including both on the part related to system/facilities and also to provider. Finally, in the preventable category (23% of all deaths), the peer review committee found that 2 deaths were having severe head injury and one had moderate head injury. Analysis of factors revealed one patient died because of provider-related deficiency and 2 patients had died of process/system related deficiencies.

## Conclusion

Head injury mortality at the Aga Khan University Hospital (12.6%) was less when compared with the overall mortality in Pakistan (15 %). In the pre-hospital setting, transfer of inappropriately resuscitated patients, lack of inter-hospital communication and inappropriate mode of transportation are significant factors identified in this study that might have contributed to high mortality. In the process or system-related deficiencies, lack of ICU beds, unavailability of portable ventilators in the emergency room, and delays in doing urgent brain CT scan in the acutely injured head trauma patients were identified. In provider-related deficiencies, there are opportunities for improvement in head trauma care that require focus on initial resuscitation, improvement in documentation and appropriate surgical management.

RECOMMENDATIONS BY THE PEER REVIEW COMMITTEE: There is need for improvements in scene care at the site of accident and provision of adequate resuscitation prior to transfer from the scene site or from the primary medical center. Inter-hospital communication should be made prior to transfer of patient either on telephone or by sending a summary of initial medical conditions. It should be ensured that mode of transportation is adequately equipped to transfer the patient.

The data gained from this peer review will be compared after certain period by doing a similar peer review to assess the efficacy of implementation of above recommendations.

ACKNOWLEDGEMENT: I am greatful to my wife Amna Javed for helping me in the preparation of this manuscript.

## References


1. Raja IA, Vohra AH, Ahmed M. Neurotrauma in Pakistan. *World J Surg* 2001;**25**:1230-7.
2. Chiu WT, LaPorte RE, Raja IA, Bouyoucef KA, Levy A. Head injuries in developing countries. In: Narayan RK, Wilberger JE, Povlishock JT Jr, (edi). Neurotrauma. New York: *McGraw-Hill*; 1996. 907-9.
3. Annegers JF, Grabow HD, Kurland LT, Laws ER. The incidence, causes and secular trends in head injury in Olmsted County, Minnessota: *Neurology*; 1980;**30**:912-9.
4. Mackenzie EJ. Review of evidence regarding trauma system effectiveness resulting from panel studies. *J Trauma* 1999;**47** (supp 3): S34-41.
5. Daniel FK, Donald PB. Advances in management of neurosurgical trauma. USA and Canada. *World J Surg* 2001;**25**:1179-85.
6. Al-Kawi MZ. History of medical records and peer review. *Ann Saudi Med* 1997; **17**:277-8.
7. Ajlouni KM, Al-Khalidi U. Medical records, patient outcome, and peer review in eleventh-century Arab medicine. *Ann Saudi Med* 1997;**17**:326-7.
8. Allen JW, DeSimone KJ. Valid peer review for surgeons working in small hospitals. *Am J Surg* 2002;**184**:16-8.
9. Trunkey DD. Invited commentary: panel reviews of trauma mortality. *J Trauma* 1999;**47** (supple 3): S44-5.
10. Takayanagi K, Koseki K, Aruga T. Preventable trauma deaths: evaluation by peer review and a guide for quality improvement. Emergency medical study group for quality. *Clin Perform Qual Health Care* 1998;**6**:163-7.
11. Phair IC, Barton DJ, Allen MJ, Barnes MR. Preventable deaths after head injury: a clinical audit of performance. *Injury* 1991;**22**:353-6.
12. Phair IC, Barton DJ, Barnes MR, Allen MJ. Deaths following trauma: an audit of performance. *Ann R Coll Surg Engl* 1991;**73**:53-7.
13. Sugrue M. Preventable death studies: an inappropriate tool evaluating trauma system. *Aust N Z Surg* 1998;**68**:611-2.
14. Deane SA, Gaudry PL, Wood P, Cass D, Holland MJ, Cook RJ, *et al*. The management of injuries: a review of deaths in hospital. *Aust NZ J Surg* 1988;**58**:463-9.
15. Zhao YD, Wang W. Neurosurgical trauma in People's Republic of China. *World J Surg* 2001;**25**:1202-4.
16. Gentlemen D, Jennett B. Audit of transfer of unconscious head-injured patients to a neurosurgical unit. *Lancet* 1990;**335**:330-4.
17. Lee LH, Shih YH, Chiu WT, Lin LS, Wu CM, Wang YC, *et al*. The epidemiology of head injuries in Taipei City, Taiwan; *Chin Med J* 1992; **19**:219.
18. Duus BR. An audit on guidelines used for the initial management of patients with minor head injuries in Denmark. *Acta Neurochir (Wien)* 1997;**139**:743-8.
19. Firsching R, Woischneck D. Present status of neurosurgical trauma in Germany. *World J Surg* 2001;**25**:1221-3.
20. Mcdermott FT. Trauma audit and quality improvement. *Aust N Z J Surg* 1994;**64**: 147-54.
21. Schwartz ML, Sharkey PW, Andersen JA. Quality assurance for patients with head injuries admitted to a regional trauma unit. *J Trauma* 1991;**31**:962-7.

2. Wallace SA, Bennett J, Perez-Avila CA, Gullan RW. Head injuries in the accident and emergency department: Are we using resources effectively? *J Accid Emerg Med* 1994;**11**:25-31.

3. Atkinson L, Merry G. Advances in neurotrauma in Australia 1970-2000. *World J Surg* 2001;**25**:1224-9.

24. Cayten CG, Stahl WM, Agarwal N, Murphy JG. Analysis of preventable deaths by mechanism of injury among 13,500 trauma admission. *Ann Surg* 1991;**214**:510-21.

25. Iau PT, Ong CL, Chan ST. Preventable trauma deaths in Singapore. *Aust NZ J Surg* 1998;**68**:820-5.