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Original Research Article

Agonies and nuances of geriatric head injury: experience of a tertiary care institute of Western India

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ABSTRACT

Background: Traumatic brain injury (TBI) is the most common cause of mortality and morbidity in emergency surgical department. The basic aim of the present study is to analyze the clinical profile, prognostic factors, impact of comorbidities on outcome and complications of traumatic brain injury in elderly patients.
Methods: The study is retrospective analysis of hospital records of all admitted patients of head injury above 60 years of age over last five years at a tertiary care institute of India.
Results: There were 94 males and 61 females in our study with male to female ratio of 1.54:1. The average age of male patients were 68.55 years and female patients were 64.50 years. Fall was the most common cause of head injury (59.3%) followed by road traffic accidents (36.8%) and assault was the least common (3.9%). Mortality was more in moderate and severe head injury groups with more propensity among females with comorbidities.
Conclusions: Our study highlights that geriatric TBI carries a significant morbidity and mortality in India despite of advances in trauma care.

Keywords: Elderly, Head injury, Senior citizen, Trauma

INTRODUCTION

The management of patients with TBI involves multiple clinical disciplines. Outcome of head injury is multifactorial and amongst those age is an important prognostic factor.[1-3]

Elderly patients of trauma present unique challenges and face more significant obstacles to recovery than younger patients.[4,5] There is a significant increase in geriatric population at global level. The aged patients require major share of I.C.U. facilities, need higher cost for treatment and rehabilitation, therefore this study is important.

METHODS

Retrospective analysis of all hospital records of admitted patients of head injury above 60 years of age over last five years was done at K.E.M. Hospital and Seth G. S. Medical College Mumbai, Maharashtra, India. Patients having penetrating head injuries and chronic subdural hematomas were excluded from the study. Total 194 elderly patients were admitted during this period. 39 patients left the hospital against medical advice due to various reasons. Therefore total 155 patients were incorporated in the study, Condition at admission was assessed by Glasgow Coma scale (GCS).[6,7] Whereas, condition on discharge was assessed by Glasgow

outcome scale (GOS) given by Jennett and Teasdale.[7,8] Probable causes of death were recorded as per the autopsy findings.

Study categorized the severity of head injury (HI) according to Glasgow Coma Scale (G.C.S.) after resuscitation in emergency department[6,7]

- Minimal HI: G.C.S. - 15, no loss of consciousness (L.O.C). Or amnesia
- Mild HI: G.C.S. - 14 or 15 plus amnesia or brief L.O.C. or impaired alertness or memory
- Moderate HI: G.C.S. - 9-13: L.O.C. greater than or around 5 minutes or focal neurological deficit
- Severe HI: G.C.S 5-8
- Critical HI: G.C.S. 3-4.

Study assessed the outcome according to the Glasgow outcome scale (GOS)[7,8]

- Death
- Persistent vegetative state - unresponsiveness and speechlessness for weeks or months until death after acute brain damage
- Severe disability (conscious but disabled) - patients are dependent for daily support, by reason of mental or physical disability, usually a combination of both
- Moderate disability (disabled but independent) - patients can travel by public transport and can work in a sheltered environment, and are independent in daily life activities. The disabilities found include varying degrees of dysphasia, hemi paresis or ataxia, as well as intellectual and memory deficits and personality changes
- Good recovery- resumption of normal life even with minor neurological and psychological deficits.

RESULTS

Over all 70 patients of colorectal malignancies were Demographic details of our study are summarized in Table 1, whereas Table 2 discusses the outcome analysis of our study. Mean age of the patients incorporated in the study was 66 years with male to female ratio of 1.54:1. The mean age in the males was 68.55 years while in the females it was 64.50 years. Fall was the most common cause of head injury (59.3%) followed by road traffic accidents (36.8%) and assault was the least common (3.9%).

The time delay from inflicting injury till admission at our institute was recorded for all patients in the study.39.2% patients were seen within 6 hours following injury and 37.2% presented more than 24 hours of injury. The mean time delay for these elderly patients was 30.5 hours. Eleven patients reported very late i.e. more than 5 days of injury and these were admitted in very poor general condition. The most common mechanism of injury sustained by elderly age group was fall (59.3%) followed by road traffic accidents (36.8%) and assault (3.9%). There were no occupational or blast injuries (Table 1).

Table 1: Clinical profile of patients.

Gender	**Male**	**94 (60.65%)**
	Female	61 (39.35%)
Mean age in years	Male	68.55
	Female	64.50
Fall	Male	55 (35.48%)
	Female	37 (23.87%)
Road traffic accident	Male	35 (22.58%)
	Female	22 (14.19%)
Assault	Male	3 (1.93%)
	Female	3 (1.93%)
Interval between injury and presentation in hours	0-6	61 (39.2%)
	07-12	20 (13%)
	13-24	17 (10.6%)
	> 24	57 (37.2%)
Pupillary reaction	Reacting	127 (83.9%)
	Nonreacting	28 (18.1%)
Glasgow coma scale (GCS)	<8	41 (26.5%)
	9 - 12	43 (27.8%)
	13-15	71 (45.7%)
Co morbidities	Present	84 (54.1%)
	Absent	71 (45.9%)
Distribution of comorbidities	Hypertension	70 (45.2%)
	Airway disorders	24 (15.6%)
	Diabetes mellitus	49 (31.8%)
	Coronary artery disease	30 (10.2%)
	Others	18 (1.2%)

There were 59.78% of male patients who had a history of fall followed by RTA (37.63%) and assault (3.22%) while 59.68% of female patients had fall followed by RTA (35.48%) and assault (4.8 %).

In order to further demonstrate the relationship of age to mortality for various levels of severity of head injury, patients were divided by GCS score at admission into three groups (Table 1), severe head injury (GCS < 8), moderate head injury (GCS 9-12) and mild head injury (GCS 13-15).

26.5% Patients had severe head injuries and most of the patients included in the study were in mild (45.7%) and moderate (27.8%) category of head injury at the time of admission.

Pupillary reaction to light also has important role in outcome. Of the 155 admitted patients, 28 (18.1%) patients had non-reactive pupils with poor GCS. There was no improvement in patients having nonreactive pupils.

Table 2: Clinical course of patients.

CT Findings	
Subdural hematoma	61 (39.3%)
Contusions	33 (21.60%)
Subarachnoid hemorrhage	9 (5.8%)
Extradural hematoma	6 (3.8%)
Diffuse brain odema	4 (2.6%)
Intraventricular/intracerebral hematoma	14 (9.2%)
Infarcts	15 (9.9%)
Multiple lesions	51 (33.2%)
Incidence of surgical pathologies	
Operative	36 (23.22%)
Non-operative	119 (76.78%)
Clinical course	
Tracheostomy	56 (36.12%)
Pulmonary complications	74 (47.9%)
Septicemia	61 (39.40%)
Deranged renal functions	33 (21.6%)
Cardiac complications	26 (17%)
Wound complications	13 (8.6%)
Deep vein thrombosis	18 (11.9%)
Meningitis	3 (2.1%)
Seizures	17 (11.1%)
Uneventful	46 (29.7%)

Many of the elderly patients (54.1%) had associated comorbid illnesses; hypertension (45.2%) was most common among them followed by chronic obstructive airway disease (15.6%), diabetes mellitus (31.8%) patients. Multiple comorbid illnesses were present in 39.1% of elderly patients (Table 1).

CT scan data (Table 2) was available for almost all patients at the time of admission. In elderly patients, acute subdural hematoma was the commonest finding (39.3%) followed by contusion (21.6%) and traumatic SAH (5.8%).

Multiple lesions were present in 33.2% elderly patients. SAH as a single entity was present in only few cases. It was mostly present along with SDH and contusion, so was grouped under multiple lesions. Diffuse brain edema was present mostly with SDH and contusion and was present in 2.6% patients as a single entity. There is statistically significant difference between presence of subdural hematoma (39.3%) and extradural hematoma (3.8%) in elderly patients (Table 2). Eleven patients could not be shifted for CT scan due to their very poor general condition throughout the course of their illness.

Various aspects of patient's outcome are summarized in Table 2. Only 29.7% of the elderly patients had uneventful clinical course during their hospitalization.

Most of the elderly patients required tracheostomy (36.12%) during their hospital course. Most common problems during hospitalization were pulmonary followed by septicemia and derangement of renal functions. The incidence of pulmonary complications in this study was 47.9% followed by septicemia (39.4%) and derangement of renal functions 21.6%). Cardiac complications (17%), local wound complications (8.6%), deep vein thrombosis (11.9%), meningitis (2.1%) and seizures (11.1%) constituted minor complications (Table 2).

Table 3: Outcome - Glasgow outcome scale (GOS).

Glasgow outcome scale (GOS)	Without Co- morbidities	With Co-morbidities	Severe head injury	Moderate head injury	Mild head injury
GOS1	14 (19.4%)	49 (57.9%)	34 (83.9%)	27 (64.1%)	15 (21.9%)
GOS 2	6 (7.90%)	15 (17.5%)	5 (12.2%)	4 (9.8%)	14 (18.6%)
GOS 3	12 (17.5%)	9 (11.2%)	2 (3.9%)	9 (21.9%)	12 (18%)
GOS 4	6 (7.9%)	7 (8.5%)	0	3 (5.2%)	15 (19.7%)
GOS 5	36 (47.3%)	4 (3.9%)	0	0	15 (19.7%)

Table 4: Mortality in percentages.

Mode of injury	Mortality rate	Case fatality rate	Gender distribution	
			Male	Female
Road traffic accidents	21.1	54.9	68.2	31.8
Fall	29.1	50	43.7	56.3
Assault	8.2	40.9	83.3	16.7

Surgery was advised in 36 cases (23.22%) out of these only 25 patients were operated because 11 families gave negative consent after understanding all the risks.

Table 3 summarizes the outcome parameters. Outcome was assessed according to the Glasgow outcome scale. GOS 4 and 5 constituted as "satisfactory functional outcome". Mortality rate was 52.1% in elderly patient. There were 19.1% patients in severely disabled state and 9.6% in vegetative state. Satisfactory functional outcome was seen in 19 % patients, 9.6% in moderately disabled state and 9.6% had good recovery. When outcome with and without comorbid diseases was examined according to age, there appeared to be an independent effect of age and outcome was worse with increasing age, even when there was no associated comorbidity.

Table 5: Gender distribution of outcome in percentage.

Glasgow outcome scale (GOS)	Males		Females	
	With co-morbidities	Without comorbidities	With co-morbidities	Without comorbidities
GOS1	47.2	52.8	57	43
GOS2	67	33	69.4	31.6
GOS3	54.1	45.9	42.5	57.5
GOS4	40	60	33.3	66.7
GOS5	16.7	83.3	36	74

Patients of severe head injury had poor outcome. Mortality was seen in 83.9% patients, whereas 5 (12.2%) patients were in vegetative state and 2 (3.9%) patients were severely disabled. None of the patient in this group had satisfactory functional outcome.

Among moderate head injury patients (GCS 9-12) no patient had good outcome. There was high mortality in this group (64.1%), majority survivals had poor outcome and only 3 patients recovered with moderate disability. Among mild head injury (GCS 13-15) group 15 (21.9%) patients died, 14 (18.6%) patients had vegetative survival, 12 (18%) patients had severe disability, 15 (19.7%) patients had moderate disability and 15 (19.7%) had good survival.

Same neurosurgical care was provided to all patients in the study but length of stay varied from 0 day (patients who expired on the day of admission) to maximum of 64 days. The average duration of hospitalization (length of stay) of all these patients was 12.2 days.

Table 4 discusses the mortality of present study. The maximum mortality was in fall group (29.1%) followed by road traffic accident (21.1%) and assault (8.2%) but the case fatality rate (i.e. the no. of deaths in that particular group) was maximum in road traffic accident (54.9%) followed by fall (50%) and assault (40.9%).

It was observed that mortality in the male patients having co-morbid condition was 52.8 % while the mortality in the female was 57% and in the absence of co-morbid conditions it was 47.2% in males and 43% in females. There was not much difference even in the satisfactory functional outcome in the presence of co-morbid condition, 40% males and 33.3% females had moderate disability and 16.7% males and 36% females had good recovery. In the absence of co-morbid condition 60% males and 66.7% females had moderate disability and 83.3% males and 74% females had good recovery (Table 5).

Table 6: Cause of death in percentage.

Cause of death in percentage	
Injury per se	29.7
Chest infections	27.3
Sepsis	19.7
Renal failure	10.3
Cardiac failure	6.3
Diabetic ketoacidosis	6.7
Meningitis	0
Seizures	0

On analysis of causes of fatal outcome (Table 6), we found that 29.7% of hospital deaths were primarily attributed to brain injury. Among the systemic causes of death, chest infection (27.3%) was the most common cause followed by sepsis (19.7%), renal failure (10.3%), cardiac failure (6.3%) and diabetes ketoacidosis (6.7%).

DISCUSSION

In this study, the male: female ratio was 1.54:1, attributed to more outdoor exposure of males and hence vulnerability to accidents and fall. This male preponderance is far less than in younger age group (4:1) which probably reflects the tendency to remain indoor with increasing age. Thus, elderly have decreased outdoor activities as compared to young. Overall road

traffic accidents (RTA) are the common cause of head injury followed by fall and assault.[9-11]

The difference in mode of injuries in elderly and young is significant as young population is more involved in outdoor activities and driving high speed vehicle in comparison to elderly, who have predominantly indoor activities.[12-15] The existing medical conditions like diabetes, arrhythmias, neuropathies, osteoporosis etc. predispose elderly patients to fall more than younger population. Elderly are less resistant to withstand trauma than young patient's due to the senile physiological alterations and common chronic diseases and are at higher risk for developing complications.[16-19]

In the present study, the fall is commonest mode of injury and maximum deaths were found in this group, but the mortality rate is highest amongst road traffic accidents groups, probably this is due to high impact injury involved in road traffic accidents and trivial trauma in patients of fall. 40.9% patients within assault died showing a very high mortality in this subgroup, whereas 54.9% patients of road traffic accidents died. The mortality in females is higher in group fall with 56.3% female patients of fall succumbing to death. The females predominantly have indoor life hence incidence and mortality due to road traffic accidents and assault are less comparing to males.

In this study 39.2% patients reported within 6 hours of injury whereas 37.2% patients presented after 24 hours. Our hospital is a tertiary care centre and receives patients who are referred from primary or secondary level centres, therefore there was delay of more than 24 hours for admission in 37.2% elderly patients.

The elderly patients have innate vulnerability to present with delayed deterioration. Many elderly patients of trivial trauma initially remain asymptomatic, present with late deterioration. Cerebral atrophy with a change in viscoelastic properties of the brain, change of mechanical properties of bridging veins and stress placed on vessels secondary to cerebral atrophy may be contributing factors.[2]

In present study, nearly half of the patients had mild head injuries with quarter of moderate and severe head injuries each. The overall mean GCS in the study group was 9.6.

Unilateral pupillary dilatation and non-reactivity to light carry a higher mortality rate and patients with bilateral pupillary dilatation carry a still higher mortality rate. In our study 18.1% patients had non-reactive pupils and 81.9 % had reactive pupils. None of the patients with non-reactive pupils (unilateral and bilateral) survived. Unilateral pupillary dilatation had mortality of 90% and with bilateral pupillary dilatation the mortality exceeds to 100%.

When study look at the associated comorbid systemic illnesses, 54.1% of the elderly patients were harboring these-problem. Hypertension was the most common (45.2%) systemic illness followed by chronic obstructive airway diseases (15.6 %).

Most of study patients were from lower socioeconomic background. When outcome with or without comorbid diseases were examined according to age, there appears to be an independent age effect and even without any associated comorbidity the outcome was worse.

In the present study, subdural hematoma (SDH) was the commonest brain lesion present in 39.3% patients followed by contusions (21.6%). Extradural hematoma (EDH) was found in 3.8 % patients. Cerebral atrophy provides space for a significant collection, so patient's neurological status may not deteriorate for a long time, because development of raised intracranial pressure is prevented due to availability of space to accommodate a large hematoma.[20] EDH is rare in elderly due to adherence of dura to skull vault, but tearing of fragile bridging veins occur more commonly even after a trivial trauma hence there is high incidence of SDH in elderly patients.[20,21] Associated comorbidities like diabetes mellitus, hypertension, asthma and drugs like anticoagulants and anti-platelets also influence the hemostasis and clot formation in brain after traumatic brain injury leading to development of large hematomas and greater midline shift in the elderly.[21-23]

All patients were provided aggressive resuscitative measures and neurosurgical care. In this study (23.22%) patients had operable lesions and (76.78%) patients had non-operative lesions.

In the present study, tracheostomy was required in 36.12% patients during their hospital stay. Tracheostomy was mostly required in severe and moderate head injury patients as compared to minor head injury patients during their prolonged hospital stay. The most common complication was pulmonary (47.9%) followed by septicemia (39.4%) and derangement of renal functions (21.6%). In the elderly marginal respiratory response is related to the loss of pulmonary elasticity. Decreased renal reserve to handle fluid challenges during resuscitation also add to the propensity for early cardiopulmonary complications.[22,23]

The age dependent nonresponsive attitude of traumatized brain may be further inflamed by hyperinflammatory state observed in the elderly, referred to as "Inflammation aging". Already existing elevated levels of proinflammatory cytokines (IL-6, TNF-α) in the circulation before injury may predispose the aged population to produce even higher concentration of these factors after injury. These over produced proinflammatory factors cause immunosuppression and increased susceptibility for sepsis.[21-23]

This shows that overall mortality is much higher in elderly patients than in younger patients. In our study, the picture was gloomy with nearly half of the patients expired and only one fifth having satisfactory functional outcome. Nearly one fifth patients were severely disabled and rests were in vegetative state. This probably is due to decreased cerebral reserves and predisposition for immunosuppression and sepsis in the elderly patients than the young patients.[21-23]

Outcome was found to be much worse in elderly with severe and moderate head injuries than in mild head injuries, hence GCS is a useful predictor regarding prognosis of elderly head injury.

Mortality was much higher in severe head injury (83.9%) and moderate head injury (64.1%) than in mild head injury (21.9%).

In the severely head injury group all the survivors except 2 were in vegetative state (3.9%), none of the patient had satisfactory functional outcome.

In the moderate head injury group only 3 patients (5.2%) had satisfactory functional outcome (moderately disabled) and rest were either severely disable (21.9%) or remained in vegetative state (9.8%).

Good recovery (19.7%) was found only in the mild head injury group, 19.7% patients had satisfactory functional outcome. severe disability was found in 18% patients and 18.6 % remained vegetative.

When the outcome of patients in relation to comorbid conditions was reviewed in this study it was found that difference in mortality was not much between comorbid group and without comorbid group. Good recovery was only made by 26% of patients having comorbid illness in comparison to 78% without comorbid illness. Large number of patients 70 % were vegetative or severely disabled having comorbid illness than those who had no comorbid illness (35 %). Thus, comorbid factors affect the extent of recovery and outcome.

There was more mortality in female patients (57%) having comorbid condition in comparison to their male counterparts (43 %).

In the present study, most (71.3%) of the elderly patient did not die from the primary brain injury but rather died because of non-neurological complications which they developed at a later point. Chest infection (27.3%) and sepsis (19.7%) were found to be most important cause of death, suggesting that functional status of the immune system is of paramount importance.

Length of stay in hospital is an indicator of morbidity. In our study mean length of stay in hospital was 8.2 days.

This shows higher expenditure and manpower consumption in elderly group as compared to young counterpart's due to more significant morbidity and more length of hospital stay.

None of the patients except two above 70 years and one above 75 years survived. It further reflects increase in mortality with senility. Mortality was highest in the severe head injury group and lowest in the mild head injury group. None of the patients in the severe head injury group showed good recovery where as it was 19.7% in the mild head injury group. There was not much difference between the mortality of patients with and without pre-existing systemic co-morbid conditions but the morbidity had definitely increased and only 26% of patients with comorbid illnesses had good recovery in comparison with 74% patients without co-morbid condition.

Senile brain is more sensitive to ischemia and has impaired regenerative capacity. Elderly patients are likely to develop large hematomas due to cerebral atrophy and delay in presentations. Comorbid conditions and other systemic complications further deter the patient from improvement.[22,23]

CONCLUSION

Elderly trauma patients present unique challenges and face more significant obstacles to recovery than younger patients. GCS and pupillary reaction at the time of admission and presence or absence of comorbid illnesses are important prognostic factors in elderly patients. Aggressive measures in elderly patients with poor neurological status can postpone death, but not the vegetative state. Therefore, decision regarding aggressive neurosurgical management has to be decided independently and carefully in consultation with family of the patients.

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REFERENCES

1. Gururaj G. Epidemiology of traumatic brain injuries: Indian scenario. Neurol Res. 2002;24:24-8.
2. Madan VS. Road traffic accidents: emerging epidemic. Ind J of Neurotrauma. 2006;3(1):1-3.
3. Ghajar J. Traumatic brain injury. Lancet. 2000;356:923-9.
4. Meldon SW, Reilly M, Drew BL, Mancuso C, Fallon W. Trauma in the very elderly: a community-

based study of outcomes at trauma and non-trauma centers. J Trauma. 2002;52(1):79-84.
5. Susman M, DiRusso MS, Sullivan T. Traumatic brain injury in the elderly: Increased mortality and worse functional outcome at discharge despite lower injury severity. J Trauma. 2002;53:219-24.
6. Teasdale G, Jennett B. Assessment of coma and impaired consciousness, a practical scale. Lancet. 1974;(2):81-3.
7. Jennett B, Teasdale G, Braakman R. Predicting outcome in individual patients after severe head injury. Lancet. 1976;5:7968-9.
8. Teasdale G, Jennett B. Assessment of coma and impaired consciousness: a practical scale. Lancet. 1974;2:81-4.
9. Munro PT, Smith RD, Timothy RJ. Effect of patients' age on management of acute intracranial haematoma: prospective national study. Br Med J. 2002;325:1001-3.
10. Thompson HJ, McCormick WC, Kagan SH. Traumatic brain injury in older adults: epidemiology, outcomes, and future implications. J Am Geriatr Soc. 2006;54(10):1590-5.
11. Dhandapani S, Manju D, Sharma B, Mahapatra A. Prognostic significance of age in traumatic brain injury. J Neurosci Rural Pract. 2012;3(2):131-5.
12. Day RJ, Vinen J, Hewitt-Falls E. Major trauma outcomes in the elderly. Med J Aust. 1994;160(11):675-8.
13. Broos PL, D'Hoore A, Vanderschot P, Rommens PM, Stappaerts KH. Multiple traumas in elderly patients. Factors influencing outcome: importance of aggressive care. Injury. 1993;24(6):365-8.
14. Volmer DG, Torner JC, Eisenberg HM, Foulkes MA. Marmarou A, Marshall LF. Age and outcome following traumatic coma, why do older patients fare worse? J Neurosurg. 1991(75):37-49.
15. Thompson HJ, McCormick WC, Kagan SH. Traumatic brain injury in older adults: epidemiology, outcomes, and future implications. J Am Geriatr Soc. 2006;54(10):1590-5.
16. Kehoe A, Smith JE, Bouamra O, Edwards A, Yates D, Lecky F. Older patients with traumatic brain injury present with a higher GCS score than younger patients for a given severity of injury. Emerg Med J. 2016;33(6):381-5.
17. Day RJ, Vinen J, Hewitt-Falls E. Major trauma outcomes in the elderly. Med J Aust. 1994;160(11):675-8.
18. Levati A, Farina ML, Vecchi G, Rossanda M, Marrubini MB. Prognosis of severe head injuries. J Neurosurg. 1982;57:779-83.
19. Susman M, DiRusso MS, Sullivan T. Traumatic brain injury in the elderly: increased mortality and worse functional outcome at discharge despite lower injury severity. J Trauma. 2002;53:219-24.
20. Mathew A, Howard III, Gross AS, Ralph G. Acute subdural hematomas: an age - dependent clinical entity. J Neurosurg. 1989:71:858-63.
21. Le Roux AA, Nadvi SS. Acute extradural haematoma in the elderly. Br J Neurosurg. 2007;21(1):16-20.
22. Zuccarello M, Facco E, Zampieri P, Zanardi L, Andrioli GC. Severe head injuries in children: Early prognosis and outcome. Childs Nerv Syst. 1985;1:158-72.
23. Shetty AK, Rao MS, Hattiangady B, Zaman V, Shetty GA. Hippocampal neurotropin levels after injury: relationship to the age of hippocampus at the time of injury. J Neurosci Res. 2004;(78):520-32.

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