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Severe head injury in the elderly: risk factor assessment and outcome analysis in a series of 100 consecutive patients at a Level 1 trauma centre

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Abstract: Incidence of head injuries is rising all over the world. Very few studies have been performed regarding severe head injury in the elderly. We aimed to study the epidemiology, mode of injury, clinical profile,management, complications and outcome in severe head injury occurring in the elderly (age e"60years). One hundred consecutive patients of severe head injury(GCSd" 8) admitted at a Level 1 trauma centre from 2006 through 2008 were retrospectively analysed. The cases were reviewed in the light of epidemiology, clinico-radiological findings, associated injuries, comorbidities, surgical intervention, post-operative complications and long-term outcome. Mean age was 63.5 years± 4.64(60-85 years, 74%male). Road traffic accident was the most common mode of injury(72%). Median GCS at admission was 5(range-3-8). CT scan revealed acute subdural hematoma in 53 (53%) patients, cerebral contusion in 53, SAH in 20, extradura hematoma in 10 and diffuse axonal injury in 11 patients. Associated comorbidities included DM in 17%, CAD in 10%, hypertension in 9%, alcoholic liver disease in 8%. Associated spinal injury was observed in 10%, abdominal solid organ injury in 5, pneumothorax in 6 patients. Eighty two patients underwent operative intervention. Remaining 18 patients were managed conservatively. Forty patients(40%) developed ventilator –associated pneumonia (VAP), meningitis(16%), septicemia(20%), coagulopathy(11%) and multi-organ dysfunction syndrome (MODS)(20%). Overall mortality was 70%. Follow up was available for 24 out of the 30 survivors (80%). Median GOS score for those patients who survived was 4(3-5) at 6m follow-up period was positively correlated with pre-admission GCS score (Correlation coefficient +0.78). Mean time interval from injury to intervention, associated comorbidities, associated spinal, orthopaedic and abdominal injury; traumatic SAH on CT head all were more common in patients with ultimate unfavourable outcome as compared to patients who survived and this difference was statistically significant (p value<0.05). Severe head injury in elderly carries a high mortality owing to associated comorbidities. Pre-admission GCS score bears a positive correlation to GOS score at 6 months follow-up. VAP with resultant septicemia is the foremost post-operative cause of death in severe head injury in the elderly.In this regard,there is a need for an integrated multi-modality multidepartmental dedicated teamwork.

Keywords: brain injury; diffuse axonal injury; elderly; head injury; intracranial hematoma

INTRODUCTION

Incidence as well as severity of head injuries is rising all over the world due to rapid industrialization and more rapid modes of transport. Unlike musculo-skeletal injuries, head injuries are more worrisome due to loss of intellectual and other cognitive faculties with a resultant burden on the family and the society. Burden is even more serious as majority of the head injury victims belong to young & productive age group. Elderly population represent an entirely different subgroup of patients compared to young adults. There is a significant increase in geriatric population at global level. In India, 6.63% of the total population above 60 years is considered elderly as described in developing countries[1]. Very few studies have been reported in literature till date regarding severe head injury in the elderly[2-8].

The elderly with head injuries do present differently from the rest of the population. Most of the elderly patients may have one or more medical disorder that may be obscured by the head injury[9]. More importantly, the medical disorder-may obscure the head injury and mislead the doctor into making a wrong diagnosis. For

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instance, hemiparesis may be wrongly attributed to a cerebrovascular accident and the traumatic intracranial haematoma may be missed[10]. The elderly patients with head injuries have a reduced cerebral reserve and are less able to withstand even a minor injury. Brain damage from head injury superimposed on pre-existing senile dementia may lead to cognitive defects, severe enough to preclude independent living[11]. This relationship between age and outcome is particularly important in severely head injured patients. With this background in mind, the authors undertook a retrospective analysis of 100 consecutive patients with severe head injury (post-resuscitation GCS $\leq$ 8) in elderly population($\geq$ 60 years) treated at a level 1 trauma centre.

MATERIAL AND METHODS

The objective of the study was to evaluate the epidemiology, mode of injury, clinical profile, complications and outcome in severe head injury occurring in elderly population ($\geq$ 60 years of age). It was a retrospective study carried out at a level 1 trauma centre in India. One hundred consecutive patients with severe head injury (post-resuscitation GCS $\leq$ 8) in patients aged $\geq$ 60 years admitted from Jan 2008 to June 2010 were included in the study. The cases were analysed with respect to age, sex, mode of injury, clinical presentation, radiological findings, associated injuries, comorbidities, surgical intervention, post-operative complications and outcome. A subgroup analysis was done comparing patients with favorable outcome to those with unfavorable outcome.

Statistical analysis: Statistical data was entered into Microsoft Excel and was analyzed using SPSS software version 15. Besides descriptive statistics, Student's t-test/ Mann-Whitney test was applied to compare continuous data in two groups. The comparison for categorical data was made by applying Chi-square/Fischer's exact test. Statistical significance was set at probability value of less than 0.05.

OBSERVATIONS

Amongst the100 patients, the male:female ratio was approximately 3:1(74 male and 26 female patients. Mean age of the study population was 63.5 ± 4.64 years (range- 60-85 years). Thirteen patients (13%) were unknown/ unattended at the time of presentation. Only severe head injury patients (post-resuscitation GCS $\leq$ 8) were included in the study. All patients were intubated in the accident and emergency services owing to poor neurological status. Median GCS at presentation was 5 (range – 3-8).

Most common mode of injury was road traffic accident (RTA) in 72%, followed by fall from height in 25% and assault in 3% (Fig 1). The clinical presentation included ENT bleed (18%), motor deficits including hemiparesis (19%), vomiting (16%) and seizure (6%) (Table 1).

All patients underwent chest X ray and abdominal sonogram following trauma as per protocol. After initial stabilization, all patients underwent a non-contrast computerized tomography (NCCT) of head and cervical spine. The CT head findings included acute subdural hematoma (SDH) in 53 patients (53%), cerebral contusion in 53%, traumatic subarachnoid haemorrhage in 20%, acute extradural haematoma (EDH) in 10% and diffuse axonal injury in 11 patients (Fig 2).

The associated injuries included cervical spine fracture and fracture dislocation in 8 patients (8%), fracture ribs with pneumothorax in 6%, dorsal spine fractures in 2%, fracture of limb bones in 7% and fracture clavicle in 1% patients. The associated visceral injuries included

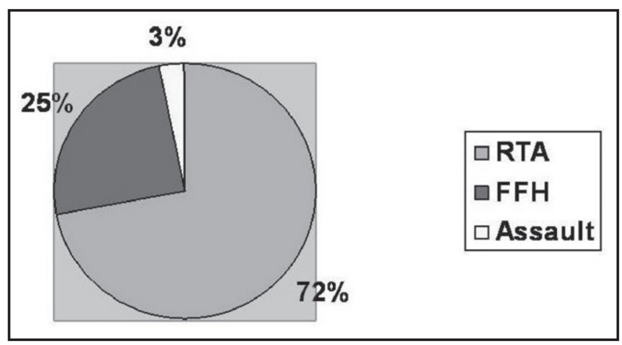

Fig 1 : Pie diagram showing mode of inury
(RTA-Road traffic accident, FFH – Fall from height)

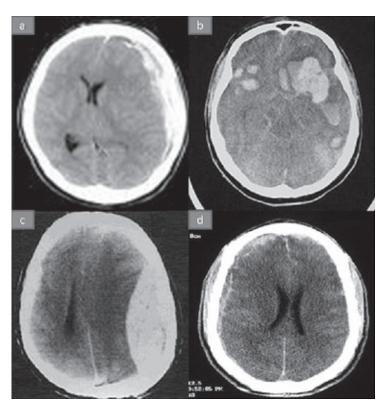

Fig 2 : CT head showing left fronto-parietal acute SDH (a), cerebral contusion (b), left fronto-parietal acute EDH (c) and traumatic SAH(d)

Table 1: Summary of the study including demographic and clinical profile of the patients (n = 100)

Mean Age (range) M:F Mode of injury	63.5 ± 4.64 yrs(60-85) 74:26 • RTA-72% • FFH-25% • Assault- 3%
Median GCS at presentation (range)	5(3-8)
Clinical presentation	Altered sensorium -100% ENT bleed-18% Motor deficits including hemiparesis -19% Vomiting-16%Seizure- 6%
CT head findings	Acute SDH-53% Cerebral contusion-53% Traumatic SAH-20% DAI-11% Acute EDH-10%
Associated injuries	# Ribs with pneumothorax-6% Splenic laceration-3% Liver laceration-2% Bladder injury-2% Enteric perforation-1% Cervical spine injuries-8% Dorsal spine injuries-2%# Both bones leg-5%# both bones forearm-2%# clavicle-1%
Associated comorbid illnesses	Diabetes mellitus-17% Hypertension-9% Coronary artery disease-10% Alcoholic liver disease and cirrhosis - 8% Chronic renal disease-1%
Perioperative complications	Intraoperative cardiac arrhythmia & death-5% Developing intracerebral contusion - 3% Operative site extradural haematoma-3% Remote site SDH-1% Remote site SDH-1%
Post-operative complications	Infarct-18% VAP-40% Meningitis-16% Septicemia-20% Coagulopathy-11% MODS-20%
Mortality	70%
Median follow-up (range)	9 m(3-24)
Median GOS score	

splenic laceration in 3 patients (3%), liver laceration in 2%, bladder injury in 2% and enteric perforation in 1% patients. Associated co-morbidities included diabetes mellitus in 17%, coronary artery disease in 10%, hypertension in 9%, alcoholic liver disease and cirrhosis in 8%, and in chronic renal disease in 1% (Table 1). All these injuries were managed as per standard protocol by a multi-modality multi-departmental trauma team consisting of a general surgeon, physician, an orthopedic surgeon, anesthesiologist and a neurosurgeon.

Eighty two patients underwent surgical intervention, whereas remaining 18 patients were managed conservatively. Those patients with unequivocal evidence of mass effect and midline shift had urgent surgical intervention; those in whom CT head findings were equivocal, intracranial pressure(ICP) monitoring was done using Codman's intraparenchymal ICP sensor. The patients who had persistently raised ICP (≥ 20 mm Hg for a continuous period of ≥30 minutes) despite maximal medical management, were subjected to decompressive craniectomy.

Surgical management included EDH evacuation in 10 patients, decompressive craniectomy and lax duraplasty in 63 patients and decompressive craniectomy, contusectomy/lobectomy and lax duraplasty in 9 patients.

Perioperative complications included intraoperative cardiac arrhythmia and death in 5%, developing intracerebral contusion in 3%, operative site EDH in 3% and remote site SDH and EDH in on patient each. Postoperative complications included infarct in 18 patients, the most common territory being PCA (14 patients) (Table 2) (Fig.3). Other postoperative complications included ventilator – associated pneumonia

Table 2: Location of post-operative infarct (n = 18)

	No. of patients
Arterial –	
• PCA territory	14
• MCA territory	01
• ACA territory	01
Venous	02

Fig 3 : CT head showing right PCA territory infarct following TBI. Note evidence of right FTP decompressive craniectomy and intracavitary drain.

(VAP) (40 patients, 40%), meningitis (16%), septicemia (20%), coagulopathy (11%) and multi-organ dysfunction syndrome (MODS) (20%).

Overall mortality in this series was 70%. Follow-up was available for 24 patients out of 30 survivors. The median follow-up was 9 months (range 3 - 24 months). The median Glasgow outcome score (GOS) for those patients who survived was 4 (range - 3-5) at six months follow-up period. Median GOS score was positively correlated with pre-admission GCS score (Correlation coefficient: + 0.78).

We also performed a subgroup analysis comparing patients with favorable outcome (30 patients) to those with unfavourable outcome (70 patients). In the subgroup analysis, mean interval from injury to intervention, presence of traumatic SAH, associated spinal injury , and comorbidities, were associated with poor outcome (p value was significant, $p<0.05$) (Table 3). Associated abdominal solid organ injury, orthopedic injury and associated alcoholic liver disease, though quantitatively higher in unfavorable outcome group, did not reach statistical significance.

DISCUSSION

There is a significant increase in geriatric population at global level. By the year 2030, twenty-percent of the population will be 65 years of age or older. Individuals 85 years and older represent the fastest growing segment of the United States population[12]. Elderly patients with traumatic brain injury (TBI) present unique and complex challenges because of various reasons.

In our study, 74% patients were male and 26% were female. The male: female ratio was 3:1 attributed to more outdoor exposure of males and hence vulnerability to

Table 3: Subgroup analysis comparing patients with favourable outcome (n=30) to those with unfavourable outcome (n=70)

	Favorable Outcome (n = 70)	Unfavorable Outcome (n = 70)	P value
Mean GCS at admission	5±1.2 (3-8)	5±1.3 (3-8)	1.0
Mean interval from injury to intervention	**3±1.25 hours (1-5 hours)**	**10±2.8 hours (3-15 hours)**	**<0.001***
Unknown	6 (20%)	7 (10%)	0.20
Spinal injury	**0**	**10 (14%)**	**0.03***
Chest injury	2 (7%)	4 (6%)	1.0
Abdominal solid organ injury	0	5 (7%)	0.31
Orthopedic injury	1 (3%)	7 (10%)	0.43
Diabetes mellitus	**1 (3%)**	**16 (23%)**	**0.02***
Hypertension	03 (10%)	06 (9%)	1
Coronary artery disease	**0**	**10 (14%)**	**0.03***
Alcoholic liver disease and cirrhosis	0	08 (11%)	0.1
Chronic renal disease	0	01	1.0
Traumatic SAH on CT head	**1(3%)**	**16(23%)**	**0.02***

(Indicates p value < 0.05 à statistically significant)*

Table 4: Summary of published series regarding severe head injury in the elderly

Year	Author	No. of patients	Mortality / Unfavorable outcome
2003	Hukkelhoven et al[2]	2664 (> 55 yrs)	74%
2009	Hanif et al[3]	120 (> 70 yrs)	74.1 %
2008	Sinha et al[6]	186 (>60 yrs)	67.8%
2008	Mitra et al	96 (> 64 yrs)	70.8 %
Present study, 2011	Borkar et al	100 (>60 yrs)	70%

fall and accident. Unsurprisingly, 45% elderly patients had some form of comorbid illness which negatively influenced their outcome. Also in a subgroup analysis comparing patients with favorable outcome to those with unfavorable outcome, we observed that associated comorbid illness(DM, Coronary artery disease), traumatic SAH on CT, associated spinal injury and mean interval between injury and intervention were statistically significant factors. Associated abdominal solid organ injury, orthopedic injury and associated alcoholic liver disease, though quantitatively higher in unfavorable outcome group, did not reach statistical significance, probably due to small sample size. Hukkelhoven et al analysed the influence of patient age on outcome following severe traumatic brain injury: in an analysis of 5600 patients[2]. They concluded that proportions of mortality and unfavorable outcome increased with age: 21 and 39%, respectively, for patients younger than 35 years and 52 and 74%, respectively, for patients older than 55 years. In their study, the odds for a poor outcome increased by 40 to 50% per 10 years of age. Hanif et al[3] studied the impact of age on outcome in patients with acute SDH following severe head injury and concluded that the mortality was significantly higher in older patients:-50% above 70 years, 25.6% between 40 and 70 years and 26% below 40 years[3]. Overall prevalence of poor outcome was also higher in older patients; 74.1% above 70 years, 48% between 40 and 70 years and 30% below 40 years. The poor outcome in acute SDH is higher in elderly patients even after surgical intervention.

Servadai et al analysed the prognostic factors in severely head injured in adults with acute SDH[4]. In terms of prognosis, the following parameters were found to be significant: age, time from injury to treatment, presence of pupillary abnormalities, GCS/motor score on admission, immediate coma or lucid interval, CT findings (hematoma volume, degree of midline shift, associated intradural lesion, compression of basal cisterns) and postoperative ICP. Our study supports most of these findings.

Gomez et al analyzed the relationship between patient age and the final outcome in a series of 810 patients aged 14 years or older who suffered a severe closed head injury[5]. They concluded that the odds of having an adverse outcome increases significantly over 35 years of age, being 10 times higher in patients older than 65 years as compared to those aged 15-25 years (reference age group). The adverse influence of an advanced age on the final outcome had not yet been satisfactorily explained, but it was thought that an older brain may have an impaired ability to recover after a pathological insult as compared to a younger one. It is believed that neuroplasticity, or the ability of the brain to heal itself and restore brain function around injured portions of the brain, decreases with age. Sinha et al[6] in their series of 186 elderly patients with severe traumatic brain injury reported a mortality rate of 67.8%. Mitra et al studied 96 elderly patients with severe head injury[7]. Two-third of the patients were non-surgically and another third underwent surgery. Overall mortality was 70.8% (n = 68). Older age and brainstem injuries were identified as independent predictors of mortality. Mortality was reported in all patients aged 85 years or older.

What makes elderly patients more susceptible to injury? Atrophy of the brain increases with age and this in turn increases the distance between the brain and the skull, making dural vessels more vulnerable to shearing damage[13]. In a comparison of patients older than and younger than 55 years, matched for injury severity and gender, it was observed that the older patient group had a significantly longer rehabilitation stay, higher total rehabilitation charges and slower rate of improvement on functional measures[14]. In a comparison of psycho-social outcomes at one year post- injury of patients with various ages, a study revealed that patients 60 years and older were significantly more disabled than those younger than 50 years of age and required more supervision[15]. In the age group of 66 to 79 years, a Glasgow Coma scale of less than 11 at the time of the injury was related to an increased risk of nursing home placement in that segment of TBI patients[16].

CONCLUSION

Severe head injury in elderly carries a grave prognosis with a mortality of around 70%. Time interval between injury and intervention is critical. Earlier the intervention, better is the outcome. Associated morbidities (diabetes mellitus, coronary artery disease) and associated spinal injury add to the poor outcome. Ventilator associated pneumonia with resultant septicemia is the foremost postoperative cause of death in severe head injury in the elderly. Pre-admission GCS score bears a positive correlation to GOS score at 6 months follow-up. In this regard, there is a need for an integrated multi-modality multidepartmental dedicated teamwork consisting of the neurosurgeon, physician, general surgeon, orthopediacian,, anaesthesiologist, neuro-nurses and physiotherapist. We feel a more dedicated effort can reduce the mortality in these patients in future.

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