

Neurotrauma in Old Aged: A Study from India

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Abstract

Introduction Traumatic brain injury (TBI) is common in all the age groups. In India with increased life expectancy and more active old-aged population, basic details of neurotrauma in old aged are limited. The aim of the present study is to determine injury pattern and factors influencing outcome of the neurotrauma in old-aged patients, and also to contribute to national trauma data.

Methods The study is based on prospective observational registry Towards Improved Trauma Care Outcomes (TITCO) database collected from four Indian government hospitals during October 1, 2013 to September 30, 2015. Data of neurotrauma patients aged 60 years or older were considered for analysis. SPSS version 24.0 was used for statistical analysis. The chi-square test was used for comparison of categorical data with significance level of $p < 0.05$.

Results Old-aged patients contributed for 1,629 (10.2%) of total neurotrauma data. Men were 2.4 times higher than women, but mortality was almost same in both the sexes. Approximately 860 (53%) of injuries were due to falls and 490 (30%) due to road traffic accidents (RTA). Approximately 708 (44%) of subjects patients had moderate to severe brain injuries. Approximately 1,136 (70%) of patients required CT scan and 435 (27%) of patients underwent brain surgery. Approximately 588 (36%) of patients expired during study period. There was significant ($p = 0.0001$) difference between mortality of old-aged and productive age group (19–59 years). The deaths between the two groups differed significantly ($p = 0.0001$) among sex, injury cause, severity, requirement of CT scan, and surgery.

Conclusion Our study highlights that geriatric TBI is a significant phenomenon and reflects our national data. Possible risk factors associated with deaths are identified in our population. More research is needed to develop specific management and preventive protocols.

Keywords

- ▶ old aged
- ▶ neurotrauma
- ▶ India
- ▶ severity
- ▶ mortality
- ▶ traumatic brain injury
- ▶ women

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Introduction

Aged population is rapidly growing in both developed and developing countries.¹⁻³ In India drastic improvements in public health and medical advance in the prevention of many diseases has led to increase in percentages of aged population. The size of old-aged population has risen from 12.1 million (5%) in 1901 to 77 million (7.4%) in 2001.² As per National Commission on Population 2011, the senior citizen accounts for 8.3% of total population.³ Based on the reports from the United Nations Population Fund and Help Age International, the number of old-aged population will shoot up to 360% that is expected to increase to 323 million, constituting 20% of total population by 2050.³ Indian has already tagged under aging nations as per 2011 census. Aging is chronic issue and it will become more severe in next decades. Old aged are more vulnerable to communicable diseases (CD) as well as noncommunicable diseases (NCD). Trauma threats in last few decades of life have made them dependants in all respects, physical, financially, etc.

The growth of aged population has become an increasing problem and presents a challenge to the present health care system. In fact, neurotrauma is one of the leading causes of neurologic disability in our country.⁴ Age is one of the most significant factors in prediction of outcome after head injury.⁵⁻¹⁰ Increasing age with decreased physiologic reserve, diminished metabolic, and hormonal response are well-recognized risk factors for poorer outcomes after head injury.^{5,6} Despite increased and adverse outcomes among brain injuries in old aged, very little epidemiologic information is available from our country. In the present study, we aim to describe the pattern of injuries and factors that determine outcome among neurotrauma patients older than 60 years.

Methods

Towards Improved Trauma Care Outcome (TITCO) is prospective observational trauma database collected from four Indian government hospital was considered in this study. TITCO data was collected for the period from October 1, 2013 to September 30, 2015. Patient details of trauma cases were recorded by trained data collectors at each pre-identified centers. For the present study, data of trauma patients aged 60 years or older were considered. In India old-aged or senior citizen means any person who has attained 60 years or above as per National Policy on Older Persons, 1999, and also as per Maintenance and Welfare of Parents and Senior Citizens Act, 2007.^{2,3} The demographic characteristics, trauma mechanisms, trauma severity scores, and outcome were analyzed. Patients in productive age group between 19 and 59 years are compared with old-aged age group.

Statistical Analysis

Statistical computations were performed using SPSS version 24.0 (SPSS Inc., Chicago, IL, United States) for Windows and Microsoft Excel version 16. Descriptive statistics was used to

report the percentages, proportions, and frequencies of demographic and outcome variables. The chi-square test was used for comparisons of the means and to test for diagonal table analysis. *p* Values < 0.05 were considered significant.

Results

The number of trauma patients' data collected during study period was 16,047. A total of 1,629 (10.2%) of these were aged 60 years or older. Mean age was 68.2 ± 7.6 years (60–97 years). Approximately 1,150 were (71%) men and 479 were (29%) women. Falls was most common cause of head injury accounting for 860 (53%), followed by road traffic

Table 1 Demographic, severity, and investigation details of old-aged TBI patients

Variables	Total n (%)
Sex	
Male	1,150 (71)
Female	479 (29)
Injury mechanism	
Assault	52 (3.5)
Burns	70 (4.5)
Falls	860 (53)
Railway	41 (2.5)
RTA	490 (30)
Pedestrian	61 (3.5)
Others	49 (3)
Transport mode	
Ambulance	1,226 (75)
Carried by man	3 (0.2)
Police	77 (4.8)
Private car	130 (8)
Auto	167 (10)
Not available	26 (2)
Glasgow coma scale ^a	
Mild	921 (56)
Moderate	259 (16)
Severe	449 (28)
Computed tomography scan	
Done	1,136 (70)
Not done	493 (30)
Brain surgery	
Done	435 (27)
Not done	1194 (73)
Deaths	588 (36)

Abbreviations: RTA, road traffic injuries; TBI, traumatic brain injury.

^aData not available for 216 (13%) patients.

accident (RTA) 490 (30%). Approximately 1,226 (75%) of patients were brought by ambulance. Mean Glasgow coma scale (GCS) was 11.01. There was statistically significant ($p = < 0.0001$) difference between GCS of dead and survived old aged with an average of 7.94 and 12.68, respectively. About two-third 1,136 (70%) of patients underwent computed tomographic (CT) scan. Approximately 435 (27%) of patients underwent emergency surgery for blood evacuation. For details refer **Table 1**.

Approximately 588 (36%) of old-aged patients expired. In 8th (men 37 vs. women 46%) and 10th (men 33 vs. women 43%) decades, frequency of women deaths is more than that of men (**Fig. 1**). Adverse physiologic findings were present in 105 (6%) for systolic blood pressure (< 90 mm Hg), 261 (16%) for tachycardia (> 100 beats/min), 140 (9%) for lesser hemoglobin level (< 10 mg/dL), 19 (1%) for tachypnea (> 20 cycles/min), and 16 (1%) for lesser blood glucose level (< 70 mg/dL). **Fig. 2A, B** shows outcome details (alive or death) during various days and months, respectively. The outcome in different days of a week and months of a year is not statistically significant.

From the same TITCO data, we analyzed 19 to 59 years (productive age group) of age group that accounted for 10,621/16,047 (66%). Mean age was 48.8 ± 4.7 (18–59 years). There was statistically significant difference between the mortality of old aged and productive age group. Also, the deaths among sex (male and female), injury cause (RTA and fall), GCS (moderate and severe), requirement of CT scan, and surgery differed significantly between the two groups. See **Table 2** for details.

Discussion

TBIs in old aged vary from countries to countries. A study from Bursa city reported 3.9%,¹¹ China reported 19.1%,¹² and data from 15 states of the United States reported 155.9 per 100,000 populations.¹³ A single institutional study from our country reported that 8.8% of TBI patients belong to old-aged age group.¹⁴ The percentages of TBI in old aged reported by

various studies are specific to cause of injury such as falls, pedestrian, etc. The present study reports 10.2% of TBIs in old aged due to any mode of injuries. In our country, old aged people account for 8.3% of total population and 10% of total TBIs. The rapid growth of old-aged population and their TBIs caution the Indian health care system for better strengthening and improving or else its consequences are likely to take it by surprise.

To our knowledge, the present study analysis is the largest report of geriatric TBI population from our country. Our results report that men are 2.4 times more affected than women, but the death rates are almost equal in both sexes. Interestingly in 8th and 10th decades, percentage of women deaths is greater than that of men (**Fig. 1**). An epidemiologic study from our country reported that female TBIs have significantly higher number of severities and deaths as compared with male TBIs, especially in old-aged age group.¹⁵ A prospective study from Scotland reported that TBI-induced death at 1-year follow-up among females (13.5%) was more than males (8.5%).¹⁶ With increasing age, women are more prone to adverse outcome, though their total population is less than men.

Falls are the most common mechanism of brain injury in old-aged population followed by RTAs.^{9,17} In developed countries such as the United States and United Arab Emirates, the falls are leading cause of TBI among old-aged patients, accounting for 51 and 55%, respectively.^{9,17} RTAs are the second most common mechanism of brain injuries accounting for 9% in the United States⁹ and 32% in United Arab Emirates.¹⁷ Our study results are consistent with findings from developed country where falls are major cause (53%) followed by RTAs (30%). However, deaths are more among RTAs (41%) than falls (30%), in our study. The injuries due to RTA will be much more severe than falls. The old-aged patients are more susceptible for RTAs because of associated medical conditions before injury and decreased body functioning as an aging process.^{9,13}

Our study analysis reports almost same percentage of old-aged patients (70%) and productive age group (72%)

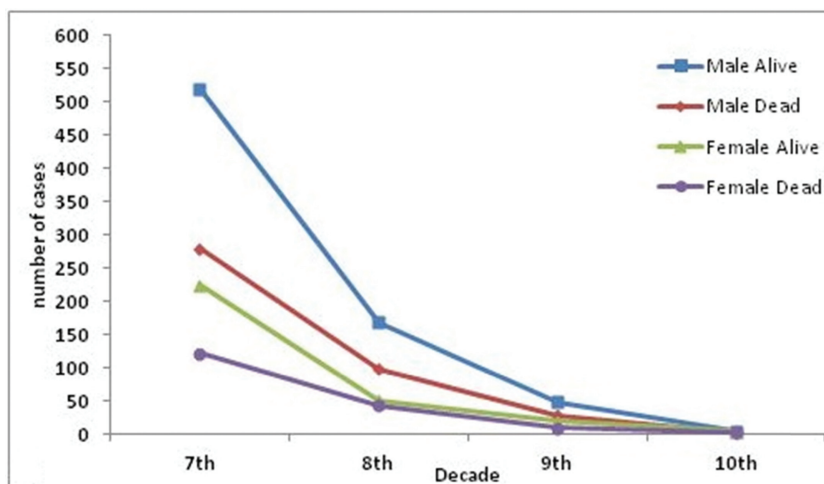


Fig. 1 Distribution of outcome among men and women in different age groups.

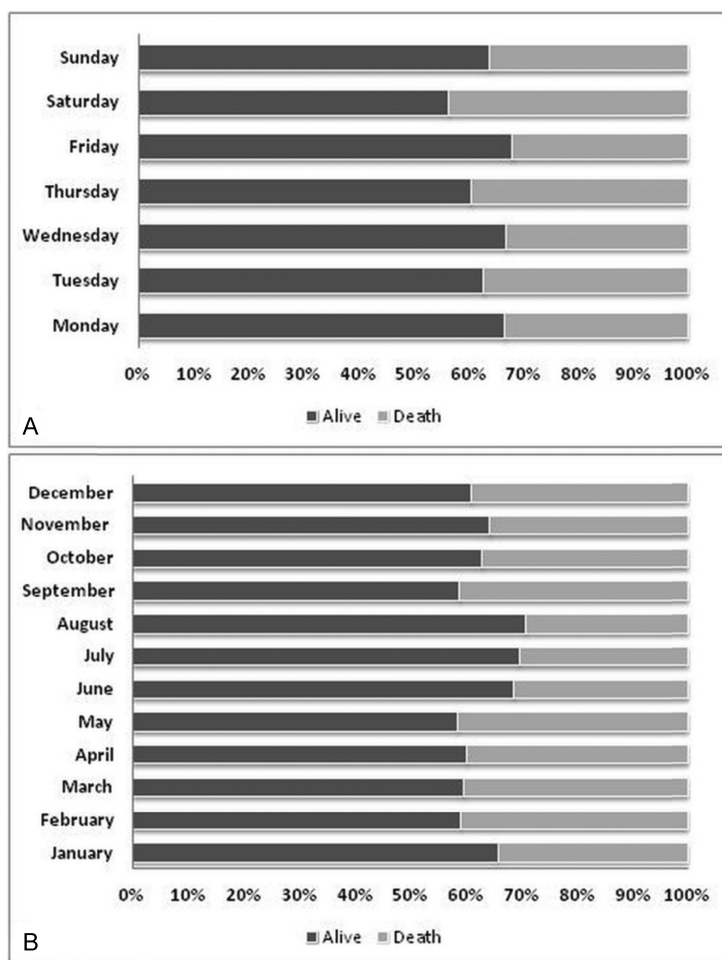


Fig. 2 Percentages of outcome (alive or death) during various days of a week (A) and months of a year (B).

Table 2 Comparison of death rates among older (≥ 60 years) versus productive age groups (19–59 years) among different variables of TBI patients

	Older age group <i>n</i> (%)	Productive age group <i>n</i> (%)	<i>p</i> Value
Total deaths	588/1,629 (36)	2,534/10,621 (24)	0.0001
Sex			
Male	409/1,150 (36)	1,955/77,548 (25)	0.0001
Female	179/479 (37)	552/1,917 (29)	0.02
Injury cause			
RTA	200/490 (41)	1,320/4,350 (30)	0.0001
Falls	262/860 (30)	552/2,429 (23)	0.0001
Glasgow coma scale			
Mild	108/921 (12)	575/5,695 (10)	0.14
Moderate	74/259 (29)	253/1,284 (20)	0.0002
Severe	306/449 (68)	1,372/2,448 (56)	0.0001
Computed tomography scan			
Done	379/1,136 (33)	1,446/7,654 (19)	0.0001
Brain surgery			
Done	136/435 (31)	613/2,583 (24)	0.001

Abbreviations: RTA, road traffic accident; TBI, traumatic brain injury.

require CT scan for any abnormal brain findings as consequence of injury. However, the deaths are almost twice among old aged as compared with productive age group who have undergone CT scan (old-aged: 33%, productive age: 19%, $p = 0.0001$). Studies have reported that old-aged patients require CT scan in approximately 77 to 83% of total TBIs.^{14,18} Our study reports that 27% of old-aged patients required surgery for evacuation of intracranial hematoma. Studies report 20 to 25% of intracranial brain surgeries for old-aged TBI patients.^{14,19} A single institute study from Newark, United States, reported that 164/823 (20%) of old-aged patients require brain surgery.¹⁹ Our study results report that percentage of deaths among old-aged patients (31%) who had undergone brain surgery is significantly ($p = 0.001$) higher than productive age deaths after surgery (24%).

The present study reports that old-aged patients had 44% of moderate to severe injury as per GCS, which is more than productive age group 35%. Deaths among old-aged population in moderate to severe GCS were more and statistically significant ($p = 0.0001$) than productive age group (► **Table 2**). The old-aged death in our study group is 36%, which is higher than that in productive age group (24%), which is significant ($p = 0.0001$). The mortality among old-aged trauma varies between 10 and 34%.^{11,14,20} Old-aged population is at risk for greater severity of injury and deaths after TBI.⁷⁻¹⁰ The possible reasons may be anatomical changes such as the dura more adherent to the skull, cerebral atrophy with greater intracranial volumes, and also routine management for associated comorbid conditions.^{9,10,12,21} Increase in old-aged population and greater mortality among old-aged TBI make this group for special attention in management aspects by clinicians and framing preventive measures by stakeholders.

Our study has so few important limitations in data source that no follow-up details are available. The study demonstrates that in-hospital mortality has an adequate measure of outcome. The study is hospital based where population-based study would have been better for generalization. Detailed variables for TBI are limited, but the basic details are provided.

Recommendations

1. There is need for developing a comprehensive care for providing preventive, curative, and rehabilitation services to the old-aged TBI patients.
2. Specialized geriatric health services should be established for creating awareness among public. Media is a good mode for spreading knowledge and communication programs related to old-aged health issues.
3. CT scans of the head should be compulsorily recommended for all patients aged 60 or older presenting with neurologic symptoms and signs or history of head trauma.
4. Multidepartmental approach is mandate for care of old-aged patients.

5. The financial and human costs of treating TBI in older adults are extensive. Therefore, the government should provide old-age-specific health insurance that covers there treatment charges.
6. Detailed survey on TBIs in old aged in all districts and states of the country should be conducted to obtain national-level data that help in framing safety measures specific to old-aged age group.

In conclusion, our study showed that old-aged population contributes a major part of neurotrauma. Old-aged women and men had almost same percentages of mortality. As compared with productive age group, old-aged patients had significantly higher severity of injury and deaths. There is need to study TBI in old-aged population in greater detail in our country, because of greater expansion of old-aged patients and expected higher TBIs.

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