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■ Original Article ■

Mortality and Morbidity in Severely Traumatized Elderly Patients

Byungchul Yu, M.D., Min Chung, M.D., GIljae Lee, M.D., and Jungnam Lee, M.D.

Department of Surgery, Gachon University Gil Medical Center, Inchon, Korea

Background: As the population ages, the elderly will constitute a prominent proportion of trauma patients. The elderly suffer more severe outcomes from injuries compared with the young. In this study, we examined the relationship between mortality and complications with age.
Methods: This study was a retrospective review of 256 major trauma patients (Injury Severity Score > 15) admitted to an emergency center over a two- year period. Age-dependent mortality and complications were evaluated.
Results: Of 256 patients, 209 (81.6%) were male and the mean age was 47.2 years. There was a trend between increasing age and increasing mortality, but this was not statistically significant. Increasing age was correlated with frequency of complications.
Conclusions: Age was confirmed to be an independent predictor of mortality in major trauma. We documented that elderly trauma patients suffer from complications more frequently compared with their younger counterparts. Appropriate and specific triage and management guidelines for elderly trauma patients are needed.

Key Words: aged; morbidity; mortality; trauma.

INTRODUCTION

Persons 65 years or older numbered 5.42 million, constituting 11.3% of the total population, accounting to 2010 Census data, signaling the advent of aged society in Korea.[1] Nationwide preparations for a rapidly aging population is evident. Trauma centers also need to get ready for increasing aging population in consideration of the association of the risk of mortality with age and Injury Severity Score (ISS) in trauma patients.[2] The centers should also consider the possibility that increasing age in patients will impinge on financial status of the national health care.[3,4]

The age of trauma patents was not regarded as an important factor when trauma centers were established for the first time in the U.S. But there has been change in the perception toward the age of patients after pediatric trauma centers successfully reduced mortality and morbidity rates by developing resuscitation techniques and practice guidelines tailored for children patients.[5] Some researchers claim that trauma centers also need to revise their service quality for growing elderly patients.[2] Developed countries initiated their research on elderly trauma patients since 1980s. However, no studies have been conducted to investigate the characteristics of trauma in elderly patients, particularly severe trauma in Korea. We therefore examined clinical features of severely injured patients admitted to the emergency unit of the hospital, which was later designated as a trauma center, to determine whether older patients had more complications related to mortality and morbidity, compared with younger patients.

MATERIALS AND METHODS

This study was conducted with 256 patients who were selected from those admitted to the emergency unit of the hospital, which is the largest in the province, due to severe injury (ISS > 15) from January 2010 to December 2012. Pediatric patients and patients with penetrating injury were excluded.

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Correspondence to: Min Chung, Department of Surgery, Gachon University Gil Medical Center, 24 Namdong-daero 774beon-gil, Namdong-gu, Incheon 405-835, Korea
Tel: +82-32-460-2140, Fax: +82-32-460-3247
E-mail: kane2123@gilhospital.com

Subjects' demographic characteristics, vital signs on admission, injury mechanism, ISS score, length of stay, length of ICU stay, the presence or absence of any complication, including death. Subjects were divided into the mortality and survival groups and subgrouped into eight age groups: 15-24 age group, 25-34 age group, 35-44 age group, 45-54 age group, 55-64 age group, 65-74 age group, 75-84 age group and ≥ 85 age group, according to the National Trauma Data Bank (NTDB).

The Denver scale.[6,7] was used to define multiple organ failure (MOF), and the clinical practice guidelines issued by American Society of Critical Care Medicine were used for diagnosis of sepsis.[8] Pulmonary complications included Acute Respiratory Distress Syndrome (ARDS), edema and respiratory failure. Cardiac complications included arrhythmia that required either drug therapy or pacemaker insertion, heart failure and cardiac tamponade.

SPSS 13.0 was used to calculate means and standard deviations, and independence samples t-test, Mann-Whitney U test, Chi-square test and one-way ANOVA were used to determine the level of statistical significance. A p-value < 0.05 was considered significant.

RESULTS

The mean age of 256 subjects was 47.2 years. Of 256 subjects, 209 were male patients (81.6%). There were 175 patients (68.4%) in the 15-24 age group, 68 (26.6%) in the 55-74 age group and 13 (5.1%) in the ≥ 75 age group. A total of 61 patients died showing a 23.8% mortality rate in total subjects (Table 1). The mean age was 52.3 ± 15.6 in the mortality group, which was higher than the mean age of 45.5 ± 17.4 in the survival group (p = 0.007). There was no significant difference between the two groups in systolic blood pressure (p = 0.063) (Table 2). Total ISS, RTS and GCS score (median, interquartile range) were 25 (11), 5.03 (1.93) and 3.5 (4), respectively, in the mortality group and 18 (9), 7.55 (1.87) and 14 (7), respectively, in the survival group. Thus the mortality group demonstrated a higher ISS but lower RTS and GSC score (Table 2). According to logistic regression analysis, death was positively correlated with age and ISS but inversely related with GCS score (Table 3) The correlation between mortality rate and age however was not statistically significant (p = 0.24) (Fig. 1), whereas the onset of complications significantly increased with age (p < 0.005) (Fig. 2). The most common causes of death were ARDS and MOF in older age groups, but no significant relationship was found between these variables and death due to small sample size (Table 4).

Table 1. Demographics

	n (%)
Age	
15-54	175 (68.4)
55-74	68 (26.6)
≥ 75	13 (5.1)
ISS	
15-24	158 (61.7)
≥ 25	98 (38.3)
Male gender	209 (81.6)
Case fatality rate	61 (23.8)

ISS: Injury Severity Score.

DISCUSSION

Aging population leads to changes in the age composition of

Table 3. Multivariable logistic regression analysis associated with mortality

	Odds ratio (95% CI)	p value
Age	1.035 (1.009-1.061)	0.007
ISS	1.129 (1.068-1.193)	0.001
SBP	0.991 (0.981-1.001)	0.078
BD	1.116 (0.986-1.262)	0.081
GCS	0.75 (0.69-0.81)	0.001

Statistically analysis by backward stepwise (Likelihood ratio) method. CI: confidence interval; ISS: Injury Severity Score; SBP: systolic blood pressure; BD: base deficit; GCS: Glasgow Coma Scale.

Table 2. Physiologic characteristics and ABGA values at arrival in survivors and nonsurvivors

Characteristics	Nonsurvivor group (n=61)	Survivor group (n=195)	p value
Age, y	52.3 ± 15.6	45.5 ± 17.4	0.007†
ISS*	25 (11)	18 (9)	0.0001‡
RTS*	5.03 (1.93)	7.55 (1.87)	< 0.0001‡
GCS*	3.5 (4)	14 (7)	< 0.0001‡
SBP at arrival	112.4 ± 41.8	119.8 ± 33.6	0.063†
Lactate at arrival*	4.3 (4.1)	2.7 (2.5)	< 0.0001‡
BD at arrival*	8.4 (10)	4.8 (6)	0.002‡
pH at arrival	7.31 ± 0.12	7.34 ± 0.09	0.011†

Values are presented as mean±SD or Median (Interquartile range). *Median (IQR). †Result of independent t-test. ‡Result of Mann-Whitney U test. ISS: Injury Severity Score; RTS: Revised Trauma Score; GCS: Glasgow Coma Scale; SBP: systolic blood pressure; BD: base deficit.

Table 4. Cause of death by age group

Age group	CNS	Hypovolemic shock	ARDS	Renal disease	MOF	Total
15-54	30 (85.7)	2 (5.7)	1 (2.9)	-	2 (5.7)	35
55-74	12 (57.1)	2 (9.5)	3 (14.3)	1 (4.8)	3 (14.3)	21
≥ 75	-	-	2 (40)	-	3 (60)	5
Total						61

Values are presented as number (%). CNS: central nervous system; ARDS: acute respiratory distress syndrome; MOF: multiple organ failure.

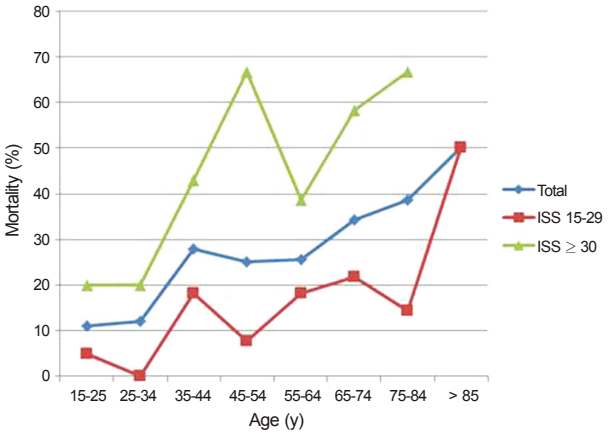

Fig. 1. Mortality rate by ISS/age. There is a trend of increasing mortaliy by age, but show no statistical significance (p = 0.24).

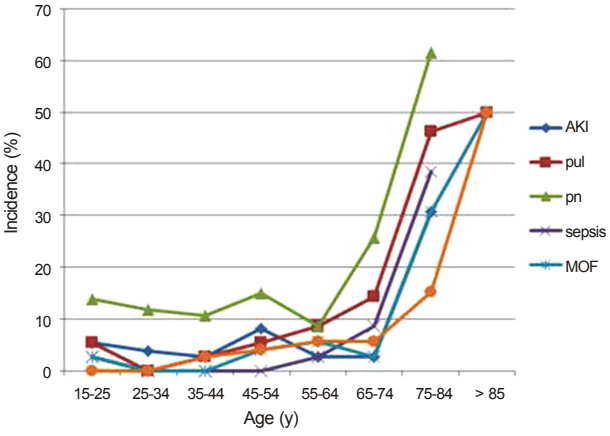

Fig. 2. Complication rate by age. There is a trend of increasing complications by age, show statistical significance (p < 0.001). AKI, pul, pn, MOF are abbreviation of acute kidney injury, pulmonary complications, pneumonia, sepsis, multiorgan failure.

severely injured patients. In 2010 Census data, persons aged 65 or over comprised 11.3% of the total population in Korea. In this study, the same age group accounted for 19.6% of total severely injured patients. The ratio of elderly patients is expected to rise. While advanced diagnostic and treatment of chronic diseases help elderly people maintain their outdoor activities, their exposure to the risk of being injured is increasing. Patient age has been suggested as an independent variable that is strongly associated with increased risk of complications and mortality in severely injured patients.[2] An underlying disease may cause severe complications and subsequent death in elderly patients although young patients would not be affected so seriously by the same disease.[9] The aim of this study was to provide useful insight for treatment of increasing geriatric trauma.

In this study, elderly patients were defined as persons aged 65 or over, although there is no consensus regarding the age threshold. The Eastern Association for Surgery of Trauma, (EAST) defined patients 55 years of age or older as older patients in its practice management guidelines for geriatric trauma.[10] Since then, there have been reports claiming mortality rate increased in patients aged 55 years or older and that complications increased in the ≥ 45 age group.[11,12] Holcomb et al.[13] reported poor prognosis in patients over the age of 45 with rib fracture. This study also found a positive correlation between patient age and complications, but the age threshold at which complications and death increased was not identified due to small sample size.

The impact of underlying disease on trauma patient outcome is still under debate. According to a study, underlying disease was not linked with mortality of trauma patients, whereas consciousness loss, intubation and ventilation during admission pose a serious death threat in trauma patients.[14] Other studies however suggested poorer prognosis in trauma patients with underlying disease, compared with those having no underlying disease.[15] Morris et al.[16] also revealed similar results, claiming that patients with underlying disease should be given high priority in medical care. However, we did not find a statistically significant association between underlying disease and mortality in the present study, probably because of retrospective design and small sample size. Further studies are needed to resolve these limitations.

The positive correlation between patient age and complications in many organs found in this study can be explained by the published evidence: Aging affects the respiratory system, reducing air sac space in lung tissue by 4% every 10 years and the lung area available for gas exchange space by 0.5% every year after age 30.[17,18] As a result, the onset of complications, including ateletasis, pneumonia and the aid of mechanical ventilation, and mortality are high in elderly patients with multiple

rib fractures.[13,18,19] Nephron number is also reduced by 10% every 10 years after age 40, reducing glomerular filtration rate and causing renal insufficiency frequently in elderly trauma patients.[17] Even though the frequency of cardiac complications was not high in this study, the risk of cardiovascular complications always exists in elderly patients. Age-related decrease in cardiac responses to catecholamine stimulation can cause cardiac ischemia or failure in the presence of underlying coronary artery disease because the aged heart cannot increase cardiac output as much as required.[18] It is therefore recommended that elderly trauma patients maintain a higher level of hemoglobin than younger patients.[20]

Some American studies suggested the transfer of elderly trauma patients to non-trauma centers rather than trauma centers had negative impacts on outcomes in elderly trauma patients.[21,22] Other studies also emphasized the importance of intensive care and observation of elderly trauma patients, regardless of injury severity.[20,23] Scalea et al.[24] attained significantly improved survival rate in geriatric trauma group by managing cardiac output of patients through invasive monitoring from the beginning, fluid resuscitation and vasopressors. Based on these studies, trauma centers are recommended for the treatment of geriatric trauma because they are better equipped to understand clinical features of elderly patients and to provide necessary care, including early invasive monitoring of cardiac output. The Korean trauma system needs to establish guidelines for differentiating which patient is transported to a trauma center or to non-trauma center. Because the current practice with regard to cardiac output monitoring does not suffice in many trauma centers, more aggressive monitoring should be performed as part of the effort to improve the quality of trauma care among elderly patients.

The present study however has the following limitations: First, selection bias cannot be ruled out because of retrospective study design. Second, the association between underlying disease and complications could not be identified because of the lack of information on underlying diseases of patients, and the results of age-related complications were likely compromised. Third, we could not collect any prehospital information that had an impact on the onset of complications and mortality of trauma patients. Because the sample size was so small, it was difficult to obtain statistical significance. Further well-structured, prospective studies are required with a large sample size.

Elderly trauma patients can develop significant complications regardless their injury severity. They need to be transferred to a trauma center rather than a non-trauma centerand closely monitored to provide necessary care in a timely and effective manner and eventually to decrease mortality and morbidity rates.

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