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A retrospective analysis of surgical outcomes for acute subdural hematoma in an elderly cohort

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ABSTRACT

Background: Acute subdural hematoma (aSDH) in the elderly is an increasingly important public health issue. Mortality rate in this population can be as high as 90% (Copper et al., 1976; Cagetti et al., 1992; Taussky et al., 2012; Hanif, 2009; Raj et al., 2016; Luerssen et al., 1988).

Objective: The goal of this study is to examine outcomes for patients 70 years and older who underwent craniotomy for aSDH.

Methods: This is a retrospective study of patients 70 years and older who underwent craniotomy for evacuation of aSDH between 2006 and 2016. Patients with subacute, chronic, acute-on-chronic SDH and those considered too neurologically devastated to benefit from surgery were excluded. A multivariable logistic regression was performed to identify independent clinical factors associated with mortality.

Results: A total of 1953 elderly patients with SDH were seen between 2006 and 2016. 1325 patients had non-surgical SDH, 307 were too neurologically devastated to benefit from surgery, and 321 elderly patients had surgery. 112 patients had a craniotomy for aSDH. The overall mortality rate was 42%. 24% of patients were discharged to home or a rehabilitation facility. Multivariable logistic regression analysis showed that age, Glasgow Coma Scale (GCS) score, and surgery type had a significant impact on mortality.

Conclusion: Elderly patients with aSDH requiring surgery have a high likelihood of mortality. 24% of surgical patients were functional enough to go home or to a rehabilitation facility from the hospital. Age over 80 years old, GCS < 9, or cerebral edema significant enough to warrant decompressive craniectomy were associated with an increased risk of death.

1. Introduction

As of 2012, the average life expectancy in the United States was 79 years old and according to the US Census Bureau, the percentage of the population over the age of 65 will increase from 13.7% in 2012 to 20.3% in 2030. As the population ages, the number of elderly patients with traumatic brain injury will also increase. To date, elderly patients up to age 65 have been well studied but those who are over 70 years old and over, are less well studied.

Traumatic brain injury (TBI) affects 1.6 million individuals in the United States, with acute subdural hemorrhage (aSDH) being one of the most common lesions [1]. Some have estimated the mortality rates for the elderly with aSDH that require neurosurgical intervention to be as high as 90% [2–7]. However, the possibility of functional survivors complicates the decision making process and the best course of action remains controversial [2, 4, 5, 8–10]. Previous studies have shown that the elderly are particularly vulnerable to aSDH following brain injury due to age related cerebral atrophy. Prognosis in aSDH has been associated with age, time from injury to treatment, presence of pupil abnormalities, and the Glasgow Coma Scale (GCS) or motor score on admission, which helped define the variables examined in our study [9].

Evidence suggests that age has a negative impact on outcome in patients with aSDH requiring surgical evacuation, showing that mortality is significantly higher in older patients [10–12]. A variety of other factors may influence the outcome in older patients including the use of

Abbreviations: aSDH, acute subdural hematoma; CI, confidence interval; GCS, Glasgow Coma Scale; ICU, intensive care unit; LTAC, long term acute care hospital; mRS, Modified Rankin Score; rehab, rehabilitation facility; SNF, skilled nursing facility

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oral anticoagulant medications, the presence of decreased functional status, and a higher rate of medical co-morbidities. This was verified by one study, which found that functional status before the injury and the use of oral anticoagulant medications influenced the prognosis of patients 75 years or older who underwent surgery for aSDH. As a result, no patients in this study who had been brought to hospital unconscious, who had not been independent before the trauma, or who had used anticoagulants were alive at one year after the surgery [10]. Despite these data, there are relatively few large studies reviewing the surgical outcomes of elderly patients with aSDH.

2. Methods

After obtaining IRB approval, a retrospective single center cohort analysis was performed. No consent from individual patients was required. Patients admitted between January 2006 and July 2016, at a level I academic trauma center, who were over the age of 70 and had acute SDH were reviewed. The patients were individually reviewed for demographics, clinical information and outcomes including age, sex, GCS on admission, pupil exam, pre-hospital co-morbidities, pre-hospital functional status, anticoagulant use, surgery type (craniotomy or craniectomy), mechanism of injury, and mean duration of stay in intensive care unit (ICU) (days). The time from admission to OR was also examined to determine if patients were taken to the OR in a delayed fashion. The outcome at discharge was determined for each patient. The primary outcome was mortality, which was defined as death during admission or discharge to hospice.

2.1. Statistical methods

Categorical variables were summarized as frequency and percentage. The differences between mortality and non-mortality groups with respect to demographics, mechanism of trauma, pupillary exam, presence of other injuries, pre-hospital functional status, pre-morbid conditions such as hypertension, diabetes, cirrhosis, heart disease, anticoagulant use, hospital complications such as pneumonia, thromboembolic events, and seizures were compared by Chi square test or Fisher's exact test as appropriate for all categorical variables. All variables in the univariable analysis with p-value < 0.20 were entered into a multivariable logistic regression model. Backward selection was performed to identify factors associated with mortality, and variables with p-value < 0.05 were included in the final multivariable model. Odds ratio and its 95% confidence interval (CI) were calculated. All statistical analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC).

3. Results

Of the 1953 patients reviewed, 1325 were non-operative and excluded from the study (Fig. 1). 307 patients were considered too neurologically devastated to benefit from neurosurgical intervention and died during admission. Patients that were excluded included those with a GCS 3–5, with or without pupil involvement combined with radiographic evidence of devastating neurologic injury. CT findings that would exclude someone from surgery included those already progressed to uncal herniation, basal cistern obliteration, and evidence of stroke. Parenchymal contusion, traumatic subarachnoid hemorrhage or shift from mass effect did not exclude patients from surgical candidacy if they had other favorable clinical characteristics. Patients with significant cardiac or pulmonary compromise were also excluded. This would include those patients who were hemodynamically unstable or unable to be ventilated with standard settings and not thought to tolerate surgery from a medical standpoint. Patients with poor neurologic exams in the setting of advanced malignancy with diffuse metastatic disease were also not considered for surgery. Patients that were not considered to be surgical candidates had a mean age of 81 years old. The most common mechanism of injury was falls from standing (80%). Other mechanisms included motor vehicle collisions (10%), automobile versus pedestrian (6%), and other types of falls like roof tops and ladders (4%). The mean GCS in this group was 5.

There were 321 patients that had operative subdural hematomas but 209 were excluded from our analysis as the subdural hematoma had subacute or chronic components. The reason patients with subacute or chronic components were excluded is because this represents a different disease entity than purely acute SDH. The type of subdural hematoma was determined by the operative note and CT report. There were 112 patients that met the inclusion criteria for the study. The vast majority of patients analyzed were injured after falls from standing, totaling 85%. The mechanism of injury for the remaining 15% included motor vehicle collisions and other types of falls, such as from roof tops and ladders (Fig. 2).

Of note, there were six patients in the surgical group who were taken to the operating room in a delayed fashion (defined as greater than one day after admission). The reason for this was neurologic worsening due to acute subdural hematoma expansion in five of the patients. One patient was thought to be neurologically devastated but showed neurologic improvement that justified surgery. The delay ranged between 1 and 3 days, with a mean of 1.6 days. Of these, 50% went to SNF or LTAC and 50% died or went to hospice. The chart was also reviewed to confirm that patients who were offered surgery were not recently admitted and discharged, then returned to the hospital with symptoms attributable to a lesion needing surgery.

Patients who were discharged to hospice or died in the hospital were grouped together as the mortality group (n = 47 patients) and the others were considered survivors. 58% were discharged to either home, rehabilitation facility (rehab), a skilled nursing facility (SNF) or long term acute care facility (LTAC), and 42% died or went to hospice (Fig. 3). Of the 65 patients who survived, 14% were discharged home, 28% were discharged to rehabilitation units, 41% were discharged to SNF, and 17% were discharged to LTAC. The average Modified Rankin Scores (mRS) were determined for each discharge disposition. For patients going home or rehab, the average mRS was 3.8. Patients going to SNF had an average mRS of 4.1. Those patients discharged to LTAC had an average mRS of 4.7 (Table 3).

Severe TBI (GCS 9 or less) was associated with mortality in the univariable analysis (Table 1, p-value = 0.01). Of patients in the mortality group, 57% were considered to have severe TBI (GCS 9 or less), and 33% of the surviving patients had GCS 9. The mechanism of trauma, pupillary exam, presence of other injuries, and pre-hospital functional status were not associated with an impact on outcome. Additionally, pre-morbid conditions such as hypertension, diabetes, cirrhosis, heart disease, and anticoagulants did not statistically impact mortality based on univariable or multivariable logistic regression analysis. Hospital complications such as pneumonia, thromboembolic events, and seizures were also not associated with an impact on mortality based on statistical analysis.

Mortality was 35% in those < 80 years old and 53% for those over 80 years old. However, 24% of patients overall were discharged home or to rehab and was similar for patients under 80 years or over 80 years old (23% versus 26%, respectively), which suggests that patient selection was an important factor for the outcomes observed. From the multivariable logistic regression analysis (Table 2), we identified age, surgery type, and whether patients had low GCS (9 or less) as factors significantly impacting mortality. Patients who were over 80 years old were 2.8 times more likely to die than patients under 80 years old (Odds ratio 2.83, 95% CI, 1.18–6.83, p-value = 0.02). Patients with a GCS < 9 were 2.9 times more likely to die than patients with mild to moderate TBI (Odds ratio 2.96, 95% CI, 1.23–7.08, p-value = 0.02). Patients who underwent craniectomy (defined as a large hemispheric decompression where the bone was left off the skull and placed in storage) were 5.7 times more likely to die than those who underwent craniotomy (Odds ratio 5.72, 95% CI, 1.11–29.32, p-value = 0.04) (Table 2). Due to the