Mortality in Elderly Patients Operated for an Acute Subdural Hematoma: A Surgical Case Series

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■ BACKGROUND: **Surgery for elderly patients with acute subdural hematomas (ASDH) is controversial, because postoperative mortality rates are reported to be high and long-term outcomes unknown. Thus, we aimed to describe midterm and long-term mortality rates of elderly patients operated for an ASDH.**

■ METHODS: **We reviewed all consecutive ≥75-year-old patients operated on for an ASDH between 2009 and 2012. We recorded data on preadmission functional status (independent or dependent) and use of antithrombotic medication. Patients were followed up a median of 4.2 years (range, 2.5—6.4 years).**

■ RESULTS: **Forty-four patients were included. The majority of the patients (70%) were independent and taking antithrombotic medication (77%). Independent patients had a 1-year mortality of 42%, compared to 69% for dependent patients; 56% of patients taking antithrombotics and 30% of those without antithrombotics died within the first postoperative year. All patients with an admission Glasgow coma scale score of 3—8 died within the first postoperative year, if they used antithrombotics or were dependent before the injury. Of all 1-year survivors, 77% were alive at the end of follow-up.**

■ CONCLUSION: **In this first surgical case series of 75-year-old or older patients with ASDH, the overall mortality rate appears to be relatively low, especially for preoperatively conscious and independent patients without antithrombotic medication. Patients alive at 1-year after surgery had a life expectancy comparable to their age-matched peers. The prognosis seems to be detrimental for preoperatively unconscious patients who were functionally dependent or used antithrombotic medication before the injury.**

INTRODUCTION

The mean age of patients with traumatic brain injury (TBI) is rapidly increasing, especially in the Western world.[1,2] During the last decades, the median age of patients with TBI has increased from 25 to 55 years, and it presumably continues to increase in the future.[3-8] Current treatment guidelines are based on studies performed on much younger study populations than commonly seen in daily practice.[9] In elderly patients with TBI, particularly, the use of antithrombotic medication together with comorbidities poses treatment challenges.

Early studies from the era preceding computed tomography have shown poor outcome for patients with acute subdural hematomas (ASDHs),[10] and even poorer outcome in the elderly.[11] Nowadays, craniotomy and hematoma evacuation is standard care for patients with expansive ASDHs.[9] For younger patients (<65 years old), large observational cohorts have reported mortality rates of 35%—55%, despite the surgical evacuation of hematoma. For patients older than 65 years, studies from the 1980s and 1990s have reported much higher postoperative mortality rates, ranging from 74% to 88%.[12-18] Since the turn of the millennium, only a few studies have reported outcomes of elderly patients with surgically treated ASDHs, and reported mortality rates have varied

Key words
- Acute subdural hematoma
- Craniotomy
- Elderly
- Mortality
- Prognosis
- Prognostic factors
- Traumatic brain injury

Abbreviations and Acronyms
ASDH: Acute subdural hematoma
CI: Confidence intervals
GCS: Glasgow coma scale
INR: International normalized ratio
IQR: Interquartile range
TBI: Traumatic brain injury

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between 35% and 50%.[19-21] However, no studies focusing on patients of 75 years of age and older have been published.

In the current study, we analyzed medium-term and long-term (1- and 3-year) mortality rates of elderly patients (≥75 years old) operated on for ASDHs in our institution between 2009 and 2012. We specifically aimed to determine the role of pretrauma functional status and usage of antithrombotic medications on mortality rates, and estimate excess mortality rates for elderly ASDH survivors.

METHODS

Study Population and Data Collection

We conducted a retrospective case series study including all elderly patients (defined as age ≥ 75 years) operated consecutively for ASDHs in our level 1 trauma center (Helsinki University Hospital) between January 1, 2009, and December 31, 2012. Our trauma center is a public, nonprofit hospital with a catchment area of nearly 2 million people, being the largest trauma center in Finland.

We included only TBI patients whose main finding was an ASDH, and who were operated on an emergency basis (median time, 7:07 hours; interquartile range [IQR], 4:40—13:46 hours after injury; **Figures 1—3**). Treatment guidelines were based on the Brain Trauma Foundation guidelines.[9] Patients with small ASDHs, not filling the Brain Trauma Foundation criteria for hematoma evacuation, or with other intracranial bleeding (e.g., large traumatic intracerebral hemorrhages, large epidural hematomas, multiple contusions) were excluded.[9] All head computed tomography scans on admission were reviewed jointly by two authors (R.R. and R.K.). Neurologic status on admission, including the Glasgow Coma Scale (GCS) score and pupillary light reactivity,[22] was assessed by an emergency department physician (neurosurgeon, anesthesiologist, or trauma surgeon).

We classified pretrauma functional status into independent and dependent. Dependent patients' functional status ranged from having home care once a day (e.g., medication, assistance, food service, housing needs) to being unable to care for themselves at home, or living permanently in a nursing home. In Finland, every patient of 75 years of age or older, being unable to care for himself or herself, has the right to home care or nursing home care according to the Finnish law (Act on Supporting the Functional Capacity of the Older Population and on Social and Health Services for Older persons [980/2012]). For example, at the end on 2014, 11.8% of 75-year-old or older people had a regular home care service (report: Home Care Clients in November 2014, 5/2015, 17.6.2015 from the Finnish National Institute for Health and Welfare, http://www.julkari.fi/bitstream/handle/10024/126302/Tk05_2015.pdf?sequence=1). When assessing service needs for the elderly people in Finland, the classification of elderly people by the functional status is commonly used by the Finnish National Institute for Health and Welfare.

Primary outcomes were 1- and 3-year mortality rates. In addition, overall survival was described for 1-year survivors. Date of death was retrieved from the Finnish population center (available for all patients). The median follow-up time was 4.2 years (IQR = 3.1—5.0 years, minimum 2.5 years, and maximum 6.4 years).

Figure 1. Ninety-year-old male patient living independently at home prior to injury with no antithrombotic medication. Admission Glasgow coma scale score was 8, both pupils were reacting to light, and the International normalized ratio was 1.1. The patient died 9 days after the operation.

The Helsinki University Hospital ethics committee (284/13/03/02/2012 12.06.2013 §128) and the Finnish National Institute approved the study and waived the need for an informed consent (Dnro THL/1830/5.05.01/2012).

Statistical Methods

Given the sample size, only descriptive statics were used. Categorical univariate variables were tested using the χ^2 test (two-tailed). Continuous normally distributed data were tested using the Student *t*-test, and skewed continuous data were tested using the Mann-Whitney U test. Categorical data is presented as numbers (%), parametric data as mean (standard deviation), and non-parametric as median (IQR). We used the 2012 IBM SPSS Statistics for Windows, Version 21.0 (IBM, Armonk, New York, USA) for the statistical analyses.

RESULTS

Baseline Characteristics

During the study period between 2009 and 2012, 1000 patients with TBIs were treated in our neurosurgical intensive care unit. Of these, 124 patients were 75 years of age or older. Of the 124 patients, 76 patients had an operable ASDH without any other major intracranial injuries. Of these, 44 patients were operated on

Figure 2. Eighty-five-year-old female patient living independently before injury and with no antithrombotic medication. Admission Glasgow coma scale score was 14, both pupils were reacting to light, and the International normalized ratio was 1.0. The patient is alive and living at home today.

Figure 3. Eighty-one-year-old female patient living in a nursing home before injury with anticoagulation medication. Admission Glasgow coma scale score was 6, both pupils were reacting to light, and the International normalized ratio was 4.5. The patient died 10 days after the operation.

and included in the present study. Of the included 44 patients, 70% (n = 31/44) were independent and 30% (n = 13/44) were dependent before injury. Only 4 patients (9%) lived in a nursing home before injury, and the rest (40 patients, 92%) lived at home.

The median and mean ages were 81 years (IQR = 77–86 years) and 82 years (SD = 5), respectively, and 48% of the patients were women. The median admission GCS score was 12 (IQR = 8–13), and 25% of patients had GCS scores between 3 and 8, suggesting severe brain injury. Moreover, 57% obeyed commands and 16% had an abnormal pupillary light reaction when presented to the emergency department. The median and mean length of hospital stay was 7 days (IQR = 3–11 days; SD = 5). Ground level falls were the mechanism of injury in 89% of the patients, 4% were subjects to road traffic accidents, and 7% had unknown injury mechanisms.

Thirty-four (77%) of 44 patients had some kind of antithrombotic medication on admission (24 patients were taking anticoagulation [warfarin], and 10 were taking antiplatelet medication).

One-Year Mortality

Differences between 1-year survivors and nonsurvivors are shown in **Table 1**. The overall unadjusted 1-year mortality was 50% (n = 22/44), and it did not differ between men (44%; 95% confidence interval [CI] = 23%–64%) and women (57%; 95% CI = 36%–78%). Nonsurvivors had significantly lower GCS scores than survivors did ($P < 0.001$). One-year mortality in patients with GCS scores of 3–8 was 91% (n = 10/11). There was no significant difference in mortality between the patients with and without antithrombotic medication (56% [95% CI = 39%–73%] and 30% [95% CI = 2%–58%], respectively), although the difference was nearly twofold. Similarly, 1-year mortality rates did not differ significantly between patients with admission International normalized ratios (INRs) >1.5 and ≤1.5 (61% [95% CI = 39%–84%] and 42% [95% CI = 23%–61%], respectively), although the absolute difference in mortality was considerable. The median INR for 1-year survivors was 1.2 (IQR = 1.1–2.3) compared with 1.7 (IQR = 1.1–2.7) for nonsurvivors ($P = 0.088$).

Patients with admission GCS scores of 3 to 8, and who also were on antithrombotics or were dependent prior to injury, had a one-year mortality rate of 100% (N=10/10 and N=3/3). For the patients with admission GCS scores between 13 and 15, the one-year mortality rate was 60% (95% CI = 17%–100%, N = 3/5) in the dependent group and 23% (95% CI = 0%–46%, N = 3/13) for those on antithrombotics.

Preoperatively independent patients had a notably lower 1-year mortality rate than dependent patients did (42% [95% CI = 25%–59%] and 69% [95% CI = 44%–94%], respectively).

Table 1. Baseline Characteristics Differences Between 12-Month Survivors and Nonsurvivors

Variables	All Patients (N = 44)	Survivors (n = 22)	Nonsurvivors (n = 22)	*P* Value
Age*	81 (77–86)	80 (77–83)	83 (79–87)	0.072
Pretrauma dependency				
Independent	31 (70)	18 (82)	13 (59)	0.099
Dependent	13 (30)	4 (18)	9 (41)	
Pre-trauma location				
Home	40 (91)	20 (91)	20 (91)	0.999
Nursing home/facility	4 (9)	2 (9)	2 (9)	
Female gender	21 (48)	9 (41)	12 (55)	0.365
Antithrombotic medication	34 (77)	15 (68)	19 (86)	0.150
Antiplatelet	10 (23)	7 (32)	3 (14)	0.174
Anticoagulation	24 (55)	9 (41)	15 (68)	
International normalized ratio*	1.3 (1.1–2.5)	1.2 (1.1–2.3)	1.7 (1.1–2.7)	0.088
> 1.5	18 (41)	7 (32)	11 (50)	0.220
Injury mechanism				
Ground-level fall	39 (89)	17 (77)	22 (100)	0.060
Road traffic accident	2 (4)	2 (9)	0 (0)	
Other	3 (7)	3 (14)	0 (0)	
Glasgow coma scale score*	12 (8–13)	13 (12–14)	9 (6–12)	< 0.001
3–8	11 (25)	1 (5)	10 (46)	0.002
9–12	15 (34)	7 (32)	8 (36)	
13–15	18 (41)	14 (63)	4 (18)	
Pupillary light reaction				
Normal	37 (84)	20 (91)	17 (77)	0.216
Abnormal	7 (16)	2 (9)	5 (23)	

Absolute values within parantheses are percentage values.
*Median (interquartile range).

Of the 6 independent patients without antithrombotic medication, 5 (83%) were alive at 1 year. In comparison, 13 (52%) of 25 of independent patients, who were also on antithrombotic medication, survived 1 year (P = 0.162).

Three-Year and Follow-Up Mortality

Differences, although not reaching statistical significance, in 3-year mortality rates were also found between patients with and without antithrombotic medication (50% [95% CI = 19%–81%] and 65% [95% CI = 49%–81%]), between those with an admission INR >1.5 and ≤1.5 (72% [95% CI = 52%–93%] and 54% [95% CI = 35%–73%]), and between dependent and independent patients (69% [95% CI = 44%–94%] and 58% [95% CI = 41%–75%]).

The median time to death was 35 days (IQR = 10–192). The median time to death for patients using antithrombotic medication was 31 days (IQR = 10–185) compared with 86 days (IQR = 32–845) for patients without antithrombotics (P = 0.257); 35 days (IQR = 11–347) for those with an admission INR ≤ 1.5 compared with 42 days (IQR = 9–203) for those with an admission INR >1.5 (P = 0.943); and 35 days (IQR = 8–71) for patients being preoperatively dependent compared with 44 days (IQR = 11–646) for patients being independent (P = 0.403).

Of 1-year survivors, 77% were alive at the end of follow-up (n = 17/22). The median age of these patients was 80 years (IQR = 77–83) at the time of injury and, thus, nearly 85 years at the end of follow-up (median follow-up time for these patients was 4.3 years). None of the 3-year survivors died during the rest of the follow-up (Figure 4).

DISCUSSION

In this first study of medium-term and long-term mortality rates after emergency surgery for ASDHs in 75-year-old and older patients, 22 of 44 operated elderly patients were alive at 1 year. Only 5 of 22 one-year survivors died during the following 2 years. Of the 17 three-year survivors, no one died during the follow-up. Thus, 1-year survivors seem to have a mortality rate comparable to their peers. As for younger patients with TBI, the level of consciousness on admission, measured using the GCS, was the major determinant of outcome in elderly patients.[23] Notably, all patients with admission GCS scores less than 9, and who also were taking antithrombotics, or were dependent before the injury, died within the first postoperative year.

To put this into perspective, the life expectancy of 75-year-old people was 9.6 years for men and 11.8 years for women in 2003 in

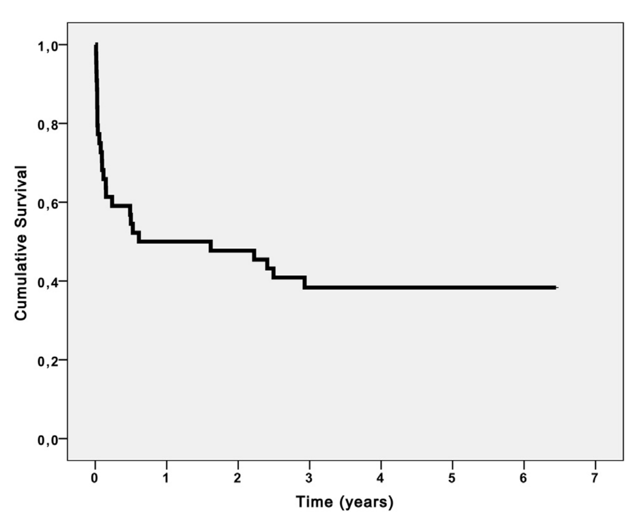

Figure 4. Kaplan-Meier curve showing overall survival of all study patients (N = 44). The postoperative mortality rate is highest within the first postoperative year. Five 1-year survivors died during the follow-up, whereas none of the 3-year survivors died by the end of follow-up.

Finland (report from Statistics Finland, http://www.stat.fi/til/ksyyt/2003/ksyyt_2003_2005-05-31_tau_001_en.html). The median age of 1- and 3-year survivors was 80 years, and their median follow-up time was 4.3–4.4 years, respectively. This considered, survival does not perhaps look so detrimental for those surviving the first years after the injury. Moreover, in comparison with the previous retrospective studies, our results fare relatively well, as the overall survival rate is similar or better than in any study for elderly patients with surgically treated ASDHs.[12-15,20,21] For example, in a recent Swedish study, the 6-month mortality rate was 41% (43% in our series) for 97 elderly (≥70-year-old) patients treated for TBI.[20] One- and 3-year mortality rates for elderly ASDH patients have not been reported before.

Patients who were taking antithrombotic medication before the injury had somewhat higher mortality rates than patients without antithrombotics. In particular, patients with INR values greater than 1.5 had a higher mortality rate than patients with normal INR values. INR has been shown to be an independent predictor of poor outcome in patients with TBI.[24-26] It is likely that patients with elevated INR values have larger and more expansive ASDHs. This view is supported by the finding of a larger midline shift in these patients in our study (median midline shift of 12 mm versus 8 mm; results not shown). In addition, the use of antithrombotic medication can also be considered an indirect indicator of cardiovascular disease, which may contribute to the higher postoperative mortality rates.

We divided pretrauma functional status into two categories: independent and dependent. Patients who were dependent (i.e., having home care or living in a nursing home) seemed to have a higher mortality rate than patients who were independent did. However, reaching statistical significances in studies with small cohorts, like the current one, are prone to type II errors. In the future, the role of pretrauma functional status on outcome after TBI should be studied in more detail.

Limitations

A number of limitations need to be acknowledged. Most importantly, because of the retrospective study design, the detailed treatment decisions were not recorded. Therefore, we cannot speculate how many patients were not admitted to our institute, and how many patients were admitted but treated conservatively. Given the probable selection and treatment biases, external validity of the study may be considered poor. However, the study aim was not to define whether elderly patients should be operated on or not, but to describe the mortality rate in a high-volume tertiary public center. If our findings indicate that the decision-making process in our institute results in an acceptable outcome for operated elderly patients with ASDHs, it may be worth considering a more detailed and especially prospective study on the subject. As the proportion of elderly patients in the Western world is growing quickly, and the use of antithrombotic medication is increasing, ASDHs may become an epidemic disease in the future, like chronic subdural hematomas seem to already be in a few countries.[1,27] At the end of 2014, 8.7% of the Finnish population was 75 years old or older (report from the Statistics Central of Finland, http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin__vrm__vaenn/020_vaenn_tau_102.px/table/tableViewLayout1/?rxid=a6ceebe7-a2ed-412a-bda4-30e5b7f6ccba), and this number is expected to rise to 14% and 16% by 2030 and 2040, respectively. Another shortcoming is that the study outcome was limited to mortality. Therefore, we cannot exclude the possibility that some of the 1- and 3-year survivors have poor functional outcomes. However, of the 22 one-year survivors, 14 patients were living at home at the end of the follow-up. Only 5 patients were living in a nursing home (3 patients were lost to follow-up), suggesting somewhat good or satisfactory outcomes, as seriously sick and disabled elderly people are rarely treated at home in Finland. In addition, this was a small case series report, which increases the risk of type I and II errors. Accordingly, our results should not be extrapolated, as they simply suggest that select elderly patients with an ASDH (good level of consciousness, independent, no antithrombotics) may have a survival benefit over another group of elderly patients (low level of consciousness, dependent, antithrombotic medication), but further prospective studies are needed to confirm this finding.

CONCLUSION

In this first surgical case series of 75-year-old or older patients with ASDH, the overall mortality rate appears to be relatively low, especially for preoperatively conscious and independent patients without antithrombotic medication. The prognosis seems to be detrimental for preoperatively unconscious patients being dependent or taking antithrombotic medication. Patients who were alive 1 year after surgery had a life expectancy comparable to their age-matched peers.

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