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ORIGINAL ARTICLE / ОРИГИНАЛНИ РАД

The impact of age, gender, acuteness, and etiology on short-term clinical outcome in patients with subdural hematomas – international dual-center study

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SUMMARY

Introduction/Objective Subdural hematoma is one of the most common intracranial types of bleeding with high risk of disability and mortality.

The aim of this study was to determine the influence of age, sex, acuteness, and etiology of subdural hematoma on short-term clinical outcome in these patients.

Methods We retrospectively studied 288 patients who were diagnosed and operated on for subdural hematomas (SDH) with different etiology (traumatic and spontaneous) and acuteness (acute, subacute, and chronic) for a period of five years. Patients scored ≤ 5 points on the Glasgow Coma Scale at hospital admission were not included in this study. Clinical outcome was assessed by the modified Rankin Scale (mRS) score at hospital discharge. Descriptive statistics and logistic regression analysis were used to determine the effect of the investigated factors on short-term clinical outcome.

Results Logistic regression analysis was conducted to predict degree of recovery (good = mRS ≤1 *vs.* poor = mRS ≥ 2 or death) using sex, age, acuteness, and etiology of SDH as predictive factors. It was established that the following three factors made a significant contribution to the outcome: age ($p = 0.004$), acuteness ($p < 0.001$), and etiology of a hematoma ($p = 0.023$), with acuteness being the strongest predictive factor. Sex was not a significant predictor, while age under 70 years and spontaneous origin of SDH were associated with lower mRS scores and had a positive effect on recovery chances.

Conclusion Age, acuteness, and etiology of hematoma are important predictive factors that influence the short-term clinical outcome in patients with SDH. These parameters should be taken into account when giving prognosis for recovery chances to a patient's family and relatives.

Keywords: subdural hematoma; outcome; predictive factors; recovery; surgery

INTRODUCTION

A subdural hematoma (SDH) is a common type of intracranial hemorrhage. The prevalence and total cost for a subdural hematoma has increased significantly in the last decade [1]. An acute intracranial subdural hematoma (ASDH) is commonly associated with high incidence of morbidity and mortality, despite its fatality rate has begun to decline with the developments in medicine and is currently around 14% [2, 3, 4]. On the other hand, some patients develop chronic SDH (CSDH) from causes other than head injury, such as brain surgery, neovascularization of the hematoma capsule, or coagulation factors. In addition, some factors, such as old age, alcoholism, coagulopathy, neurological status at admission, hematoma density, and irrigation, are reported to be correlated with the outcome [5]. However, these results are still controversial, and the influence of some important predictive factors on clinical outcome of SDH, regardless of its etiology and acuteness, has not yet been fully elucidated.

Therefore, the aim of this study was to determine the influence of age, sex, acuteness, and etiology on short-term clinical outcome in patients with subdural hematomas.

METHODS

Study design

This international study was performed in two neurosurgical centers – the Clinic for Neurosurgery, Clinical Center of Niš, Serbia, and the Clinic for Neurosurgery, St George University Hospital, Plovdiv, Bulgaria. It was approved by the institutional review boards, and informed consent was waived. Patient information was obtained via a retrospective review of medical records for the period between January 2011 and December 2015.

Patients

We identified and included a total of 288 patients diagnosed and operated on for SDHs,

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Table 1. Group comparisons of the investigated factors and their correlation with clinical outcome

Factors	No. of patents (%)	p-value	mRS			p-value
			mean	SE	median	
Age						
≤ 70	138 (47.9)	ns	1.40	0.14	1	0.002
> 70	150 (52.1)		1.99	0.16	1	
Sex						
male	198 (68.8)	< 0.001	1.63	0.12	1	ns
female	90 (31.3)		1.88	0.21	1	
Acuteness of SDH						
acute	44 (15.3)	< 0.001	3.16	0.30	3	< 0.001
subacute/chronic	244 (84.7)		1.45	0.11	1	
Etiology of SDH						
spontaneous	179 (62.2)	< 0.001	1.49	0.13	1	0.008
traumatic	109 (37.8)		2.06	0.19	1	
Total	288 (100)		1.71	0.11	1	

mRS – modified Rankin Scale; ns – non-significant; SDH – subdural hematoma

regardless of their acuteness (acute, subacute, or chronic), and etiology (traumatic or spontaneous). We collected data with relation to factors such as initial score on the Glasgow Coma Scale (GCS), length of hospital stay, age, sex, acuteness, and etiology of SDH. The short-term clinical outcome was assessed by the modified Rankin Scale (mRS) at hospital discharge. Thus, the follow-up period varied from seven to 35 days. Patients scored ≤ 5 points on the GCS at hospital admission were not included in the study because they usually have moribund prognosis.

In order to determine the influence of the investigated factors on the clinical outcome, the patients were grouped for comparisons as follows: patients aged ≤ 70 years *vs.* patients aged > 70 years; male patients *vs.* female patients; patients with acute SDH *vs.* patients with subacute/chronic SDH; patients with traumatic *vs.* patients with spontaneous (non-traumatic) SDH.

Statistics

Statistical analyses were performed using the IBM SPSS Statistics for Windows, Version 19.0 (IBM Corp., Armonk, NY, USA). Distribution of the variables was tested using the Shapiro–Wilk test. We used the Mann–Whitney U-test to test for differences between groups and correlation analyses (Spearman's r). Logistic regression model was run to determine which variables were independently associated with functional recovery and mortality. All variables with $p < 0.05$ were considered statistically significant.

RESULTS

The mean age was 69.62 ± 0.79 years (range being 20–95 years), with 52.1% being over the age of 70 years. Male-to-female ratio was 2.2:1. The most common types of SDH were subacute/chronic (84.7%) and spontaneous (62.2%). The overall mortality rate was 10.4%. The average mRS score upon discharge was 1.71 ± 0.11. Sex was not significantly associated with differences in mRS score nor with the other factors ($p < 0.05$). Being above/below the age of 70 years was significantly associated with differences in the mRS score ($U = 8{,}307.5$, $p = 0.002$) and the outcome (independence, dependence or death) ($U = 9{,}124.5$, $p = 0.016$). Outcome (mRS score) was also associated with the acuteness ($U = 2{,}578$, $p < 0.001$) and etiology of SDH ($U = 8{,}014$, $p = 0.008$) (Table 1).

There was a moderate negative correlation between the acuteness and the mRS score (Spearman's $r = -0.339$, $p < 0.001$).

Clinical outcome and correlation between good recovery and investigated factors have been summarized in Tables 2 and 3.

A logistic regression analysis was conducted to predict degree of recovery (good = mRS ≤ 1 *vs.* poor = mRS ≥ 2 or death) using sex, age, acuteness, and etiology of SDH as predictors. A test of the full model against a constant only model was statistically significant, indicating that the predictors were reliably distinguished between acceptors and decliners of the offer ($\chi^2 = 49.535$, $p < 0.001$ with $df = 4$). Nagelkerke's R^2 of 0.218 indicated a relationship between prediction and grouping. Prediction success overall was 72.6% (94.1% for good and 32.7% for poor). The Wald criterion demonstrated that three factors made a significant contribution to prediction: age ($p = 0.004$), acuteness ($p < 0.001$) and etiology of SDH ($p = 0.023$), with acuteness being the strongest predictor. Sex was not a significant predictor, whereas age under 70 years and spontaneous origin of SDH were associated with lower mRS scores and had positive effect on recovery chances.

DISCUSSION

Many factors, including age, have been reported to influence the outcome in traumatic and non-traumatic SDH patients [6, 7, 8]. Age is considered as one of the major predictive factors for mortality in patients with traumatic

Table 2. Summary of clinical outcome and functional recovery of patients with a subdural hematoma at discharge

Clinical outcome	No. of patient (%)
mRS	
no symptoms	68 (23.6)
no significant disability	119 (41.3)
slight disability	38 (13.2)
moderate disability	17 (5.9)
moderate severe disability	14 (4.9)
severe disability	2 (0.7)
death	30 (10.4)
Outcome (based on mRS)	
independent (mRS = 0–2)	225 (78.1)
dependent (mRS = 3–5)	33 (11.5)
death	30 (10.4)
Recovery of surviving patients (n = 258)	
good/full recovery (mRS ≤ 1)	187 (72.5)
poor/disability (mRS = 2–5)	71 (27.5)

mRS – modified Rankin Scale

Table 3. Correlations between the investigated factors and good clinical outcome

Factors	Functional recovery (mRS ≤ 2) n (% within group)	p-value
Age		
≤ 70	116 (84.1)	0.016
> 70	109 (72.7)	
Sex		
male	156 (78.8)	ns
female	69 (76.7)	
Acuteness of SDH		
acute	21 (47.7)	< 0.001
subacute/chronic	204 (83.6)	
Etiology of SDH		
spontaneous	149 (83.2)	< 0.05
traumatic	76 (69.7)	
Total	225 (78.1)	

mRS – modified Rankin Scale; ns – non-significant; SDH – subdural hematoma

ASDH [9]. A recent study reported that the age of less or more than 77 years had been found to be an independent prognostic factor for the functional outcome in patients with CSDH [10]. Age is also indicated as a positive risk factor for a higher perioperative morbidity and mortality [11]. On the other hand, other authors shared that despite significantly higher complication rate in elderly patients with CSDH, the clinical outcome at one month after surgery in patients older than 85 years was significantly better in comparison to patients younger than 85 years [11]. On the contrary, in a large, prospective, multicenter, observational cohort study carried out in the United Kingdom by Brennan et al. [12], over 1,205 patients with CSDH, showed that increasing patient age had independently predicted unfavorable functional outcomes [12]. Another large study conducted by Toi et al. [13], which included 63,358 patients with newly diagnosed CSDH, also confirmed that the percentage of poor outcomes at discharge tended to be higher in elderly patients. Several publications demonstrated that clinical outcome of patients over 70 years old who have received surgical treatment for traumatic ASDH was significantly worse with the increase in age [14, 15, 16]. Our study found that patients with subdural bleeding older than 70 years had poorer short-term outcomes following surgery compared to those younger than 70 years. We identified the age less than 70 years as a significant predictor for better outcome in a mixed cohort of patients with SDH, regardless of its acuteness and etiology. Similar findings have been recently reported [17].

A recent study showed that premorbid impaired activities of daily living, consciousness disturbance, acute-to-chronic subdural hematoma, and death as outcomes at discharge were significantly more frequent in women than in men. Women had less frequent instances of good recovery. Female sex was also identified as a predictor of death at discharge [18]. In contrast, our study did not identify sex to be significantly associated with differences in outcome. Logistic regression analysis confirmed that sex was not a significant predictor of clinical outcome of patients with SDH, a fact also observed by other authors [9]. The prognosis for patients with ASDH remains poor, especially in elderly patients [19]. It has long been recognized that ASDH is often associated with intraparenchymal injuries and brain swelling. Hence, outcomes have historically been worse for patients with ASDH with mortality rates as high as 68% [20, 21]. Pathophysiology, patient populations, management strategies, and outcomes differ significantly between ASDH and CSDH [22]. As recently reported, patients with mixed acuteness or subacute/chronic SDH had significantly better three-month mRS with surgery compared to those with only ASDH [17]. In contrast, another study which investigated 45 patients over the age of 70 did not establish any change in the functional status from admission to follow-up in the groups of patients with ASDH and CSDH [23]. We also confirmed that acuteness of SDH was significantly correlated with functional recovery and outcome. Moreover, the acuteness was found to be the strongest predictor of clinical outcome. Our study suggested that patients with ASDH tend to have poorer outcome and lower chances for good recovery compared to patients with subacute/chronic SDH.

Patients with CSDH who reported a history of head injury are susceptible to poorer outcome [5]. However, SDH can develop spontaneously, without any history of sustained cranial trauma as a result of brain surgery, neovascularization of the hematoma capsule, or coagulation factors [5, 24, 25]. The etiology remains unknown in over 25% of cases because many patients have not experienced a prior traumatic event [26, 27]. We found significant correlation between etiology of SDH and clinical outcome. The etiology of SDH was also found to be a significant predictor of outcome. Our results indicated that patients with spontaneous (non-traumatic) SDH had better outcome and greater recovery chances after surgery than patients with traumatic SDH. One possible explanation is that traumatic SDH are often accompanied by a variety of diffuse parenchymal injuries and cerebral edema that increase brain damage and worsen prognosis.

We could not identify any other publication in the literature that discusses and compares clinical outcome in patients with spontaneous versus traumatic SDH with heterogeneous acuteness. Therefore, we consider this our original finding that could have social, economic and, chiefly, personal significance. Recovery of such patients and their ability to adequately participate in everyday life has a great impact on their quality of life.

CONCLUSION

In this study we documented that age, acuteness, and etiology of hematomas are important predictors of short-term clinical outcome in patients with SDH. Based on this, neurosurgeons can give a more accurate prognosis about the disease course and the outcome. Further studies are needed to elucidate the influence of these factors on long-term clinical outcome.

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Утицај старости, пола, динамике настанка и етилогије на краткорочни клинички исход код болесника са субдуралним хематомима – међународна двоцентрична студија

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САЖЕТАК

Увод/Циљ Субдурални хематоми су један од најчешћих видова интракранијалног крварења, са високим процентом морталитета и морбидитета.

Циљ нашег истраживања је био да утврдимо утицај старости, пола, динамике настанка и етиологије субдуралних хематома на краткорочни клинички исход код ових болесника.

Методе Ретроспективно смо анализирали 288 болесника који су оперисани од субдуралних хематома (СДХ) различите етиологије (трауматски или спонтани) и динамике настанка (акутни, субакутни и хронични) у периоду од пет година. У студију нису укључени сви болесници са Глазгов кома скалом ≤5. Клинички исход је утврђиван помоћу модификоване Ранкин скале (мРС) непосредно пре отпуста са клинике. Описна статистичка и логистичка регресиона анализа су коришћене за утврђивање ефекта испитиваних фактора на краткорочни клинички исход.

Резултати За предвиђање степена опоравака коришћена је метода логистичке регресионе анализе (добар = мРС ≤ 1 насупрот лошем мРС ≥ 2 или смрти), која је узимала у обзир старост, пол, динамику настанка и етилогију СДХ као факторе прогнозе. Утврђено је да су три фактора од статистичког значаја за степен опоравка: старост ($p = 0,004$), динамика настанка ($p < 0,001$) и етиологија хематома ($p = 0,023$). Пол болесника није био од прогностичког значаја, док су старост испод 70 година и нетрауматско порекло хематома удружени са ниским мРС имали позитиван ефект на опоравак.

Закључак Старост, динамика настанка и етилогија хематома су битни прогностички фактори који утичу на краткорочни клинички исход код болесника са СДХ. Ови параметри би требало да се узму у обзир када се даје прогноза опоравка.

Кључне речи: субдурални хематом; исход; прогностички фактори; опоравак; операција