

FOLIA MEDICA CRACOVIENSIA

Vol. LVIII, 1, 2018: 53–56

PL ISSN 0015-5616

# Prolonged international normalized ratio is independently associated with recurrence of acute subdural hematoma needing reoperation

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**Abstract:** **Introduction:** Acute subdural hematoma (aSDH) removal is one of the most commonly performed procedure in neurosurgery. Complications of those surgeries which require reoperation are associated with higher risk of poor treatment outcome. Therefore we decided to analyse potential factors which might be associated with risk of early reoperation among patients who underwent aSDH surgery.

**Materials and methods:** We retrospectively analysed 328 patients treated due to aSDH. From their medical records we obtained detailed medical history. Early reoperation was defined as reoperation during the same hospital stay. To determine the potential predictors of early reoperation we used univariate and multivariate logistic regression analyses.

**Results:** A total of 20 (6.09%) patients required early reoperation. Those patients had significantly higher International Normalized Ratio (INR) upon admission ( $1.96 \pm 2.55$  vs.  $1.26 \pm 0.50$ ;  $p < 0.01$ ) and significantly higher Prothrombin Time (PT) upon admission ( $21.84 \pm 27.10$  vs.  $13.40 \pm 3.45$ ;  $p < 0.01$ ). In multivariate logistic regression analysis after adjustment for all possible confounders higher INR (OR: 1.762; 95% CI: 1.017–22.840;  $p = 0.045$ ) remained independently associated with higher risk of early reoperation among patients with aSDH.

**Conclusions:** Patients with higher INR and PT upon admission are at higher risk of early reoperation. Higher INR is independently associated with higher risk of early reoperation among patients with aSDH.

**Key words:** acute subdural hematoma, reoperation, prothrombin time, traumatic brain injury.

## Introduction

There are many studies presenting treatment results of Traumatic Brain Injury (TBI) caused by acute Subdural Hematoma (aSDH) and discussing influencing factors [1]. Most of the authors emphasise the initial neurological status and the severity of the trauma as one of the most important prognostic factors [2, 3].

Nevertheless the course of surgical treatment has also significant impact on outcome after TBI [4]. Complication in term of recurrent hematoma leading to reoperation impair substantially the treatment results. In cranial neurosurgery the reoperation ratio due to haemorrhage varies between 0.77–6.9% [5]. In the studies concerning TBI treatment reoperations due to secondary clot reaccumulation ranged from 6.9 up to 9.1% [5, 6].

In our study we decided to investigate factors influencing the early recurrence of the acute subdural hematoma which required another surgery during the same hospital stay.

## Patients and methods

We retrospectively analyzed 328 patients hospitalized between January 2013 and December 2016 with CT-confirmed aSDH who underwent surgical procedures. Upon admission patients were assessed using Glasgow Coma Scale (GCS). From their medical record we obtained detailed medical history which included previous diseases and current medications. We also obtained blood test results taken within 24 hours before the surgery together with details concerning operation such as its date, type and side and whether the doctor who performed the surgery and their assistant were specialists in neurosurgery. Coagulation parameters such as Prothrombin Time (PT) also shown by International Normalized Ratio (INR) and Activated Partial Thromboplastin Time (APTT) were taken into consideration. Type of craniotomy was defined by anatomical localization and surface area. Surface area was defined by number of convexity bones that were contained in craniotomy. Early reoperation was defined as reoperation that occurred during the same hospitalization due to a primary neurosurgical condition. Study protocol was approved by local bioethical committee.

We used  $\chi^2$  test to test proportion. T-test and Mann-Whitney U test were used as appropriate for continuous variables. To determine the potential predictors of reoperation after aSDH surgery we used univariate and multivariate logistic regression analysis. P-values <0.05 were considered to be statistically significant. Threshold of p-value <0.1 was used to qualify data to multivariate logistic regression analysis. Forward logistic regression analysis was followed by backwards logistic regression analysis. To perform all statistical analysis we used STATISTICA v. 10 for Windows (Statsoft, Poland).

## Results

Our study group consisted of 328 patients and 30% of them were females. Mean age of study group was  $70.22 \pm 15.61$  years and mean GCS upon admission was  $13.14 \pm 3.62$ . A total of 20 (6.10%) patients manifested with recurrent SDH needing reoperation. Those patients had significantly longer PT ( $21.84 \pm 27.10$  s vs.  $13.40 \pm 3.45$  s,  $p < 0.01$ ) and INR ( $1.96 \pm 2.55$  vs.  $1.25 \pm 0.50$ ,  $p < 0.01$ ). Details concerning medical history, current medications and blood test results are presented in Table 1. Details concerning surgery are presented in Table 2. After adjustment of all possible confounders, prolonged INR (OR: 1.76, 95% CI: 1.007–3.081,  $p = 0.045$ ) remained independently associated with higher risk of early unplanned reoperation.

## Discussion

In this retrospective study we established the frequency of recurrent aSDH requiring reoperation at 6.09%. Moreover we found that prolonged INR is independently associated with risk of aSDH recurrence. In our institution patients with INR >1.5 are receiving Fresh Frozen Plasma (FFP) prior to surgery. In case of neurological status worsening patients receiving FFP during emergency surgery.

Problem of recurrent aSDH is rarely addressed in the literature. This is one of the very few studies focusing on prediction of aSDH recurrence. Due to the best of our knowledge there are no studies showing relation between coagulation markers and risk of recurrent aSDH requiring reoperation.

Wafaisade *et al.* found that coagulopathy was present in 22.7% of patients with aSDH [7]. It was associated with a number of clinical factors such as admittory Glasgow Coma Scale, Injury Severity Score and Abbreviated Injury Scale. This study has not examined relation of coagulopathy to recurrence of aSDH or treatment outcome [7]. Lemcke *et al.* found that prolonged INR is significantly associated with risk of poor treatment outcome after aSDH [8]. Presence of coagulopathy have been described with increased risk of death in patients with aSDH [9]. Unfortunately most

of the studies examining couagulopathy in aSDH are limited to patients admitted to Intensive Care Unit [7, 9].

In conclusion abnormal INR carries high risk of recurrent aSDH requiring reoperation. Normalization of the INR prior to surgery is necessary to avoid recurrent aSDH.

### Acknowledgments

None.

### Conflicts of interest disclosure

No declared.

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