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Clinical commentary

# Preoperative assessment of haemostasis in patients undergoing stereotactic brain biopsy

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ABSTRACT

Parenchymal hemorrhage is considered a major risk factor for perioperative morbidity in patients undergoing stereotactic brain biopsy. Studies on patients undergoing surgical procedures have suggested that evaluation of prothrombin time (PT) and activated partial thromboplastin time (aPTT) is of limited value with regard to prevention of haemorrhagic complications. However, this issue has not yet been addressed in patients undergoing stereotactic biopsy of intracranial lesions. We retrospectively analysed the medical records of 159 consecutive patients undergoing stereotactic biopsy of supratentorial intracranial lesions during a three-year period. Laboratory values (PT, aPTT, platelet count) were reviewed as well as clinical characteristics, modalities of surgical treatment, histopathological results and the postoperative course of patients. The overall diagnostic yield was 93.7%. Histopathological examination revealed glioma (WHO°I: 5, WHO°II: 25, WHO°III: 23, WHO°IV: 65), lymphoma (n = 14), inflammation (n = 8) and other entities (n = 6). Surgery-associated neurological deficits occurred in 7 patients (4.4%) and completely resolved in 6 of these patients. CT-confirmed intracranial hemorrhage occurred in 2 patients (1.3%) and in both cases, histopathological examination revealed glioblastoma. Results of hemostatic parameters (PT: 99 ± 13%, aPTT: 24 ± 3s, platelet count: 274 ± 87 $10^3/\mu L$) were within normal range values in all patients and did not correlate with postsurgical morbidity. Standard assessment of haemostasis seems to be of limited value in patients with intracranial lesions undergoing stereotactic biopsy. Further studies regarding the intratumoural vasculature's impact on the risk of biopsy-related bleeding are necessary.



## 1. Introduction

Stereotactic biopsy has been established as a standard diagnostic procedure in the treatment of patients with brain lesions [1]. However, parenchymal haemorrhage occurring during or after surgery can lead to neurological deficits or even a fatal patient outcome. Favre et al. reported an incidence of 1.7% for parenchymal haemorrhage in a series of 361 patients undergoing stereotactic brain procedures [2]. Several factors may have a crucial impact on bleeding complications during stereotactic surgery. These factors include intraoperative trajectory planning to avoid cerebral vessel puncture, course of anaesthesia, patient comorbidities and intravascular biology of tumours. Importantly, coagulopathy is considered a major risk factor for haemorrhage during surgery.

There has been a debate regarding the assessment of haemostasis in patients prior to surgical procedures. Laboratory assessment of standard haemostatic parameters in patients undergoing elective surgical procedures are commonly carried out and include prothrombin time (PT), activated partial thromboplastin time (aPTT) and platelet count (PC). However, it has been questioned whether this assessment is suitable to identify relevant coagulopathies in surgical patients. In this article we report on our experience with 159 patients undergoing stereotactic biopsy of supratentorial brain lesions at our institution by a single surgeon. Patient characteristics as well as surgical modalities and patients' further courses were analysed with specific focus on results of

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laboratory assessment of haemostasis and incidence of postoperative haemorrhage.

## 2. Materials and methods

This study was approved by the local Ethics Committee. Medical records of all adult patients who underwent stereotactic biopsy of a supratentorial brain lesion by the senior author between January 2010 and December 2013 were retrospectively analysed. Patients were referred to neurosurgical service if histopathological examination of tissue was warranted. Patients were examined through magnetic resonance imaging (MRI) and were clinically examined by a neurosurgeon. All patients were subjected to examination of blood samples including a full blood count, glucose, electrolytes, urea, creatinine, aPTT, and PT. Furthermore, a specific questionnaire regarding bleeding tendencies as previously described was completed by patients and in-vivo subaqual bleeding time was determined [3]. After preoperative preparations were completed, the procedure was performed under general anaesthesia. Following fixation in a Fisher-Leibinger stereotaxy frame, intraoperative MRI (Magnetom 1.5T, Siemens, Munich, Germany) was performed for definition of the biopsy target and trajectory planning. Trajectory planning based on obtained MRI scans was carried out with stereotactical planning software (inomed, Emmendingen, Germany) and Riechert-Mundinger and Zamarano-Dujovny frames. After burr-hole trepanation, the biopsy needle was inserted and biopsy samples were harvested. The wound was closed and anaesthesia was terminated. Following extubation, the patient was examined by a neurosurgeon for detection of procedure-related symptoms. A CT scan was only performed in cases of neurological deterioration or for exclusion of haemorrhage because of the patient's risk profile.

Patients received a high-dose steroid therapy postoperatively and further treatment was initiated depending on the final diagnosis after histopathological examination of biopsy samples.

## 3. Results

### 3.1. Patient characteristics

Between January 2010 and December 2013, a total of 159 patients (male: 88, female: 71) underwent stereotactic biopsy of a supratentorial brain lesion by the senior author (K.L.K.) Patient details and findings of laboratory examination are described in Table 1. The results of laboratory examination were within normal ranges in all patients.

### 3.2. Surgical procedures

All surgical procedures were carried out under general anaesthesia and no bleeding complications occurred during surgery. The mean number of biopsy samples was 17 (range: 3-31).

### 3.3. Postoperative course and histopathological results

In 7 patients, neurological deficits occurred following surgery and in two patients, CT imaging demonstrated biopsy-related intracerebral haemorrhage (Table 2). In all cases, haemostatic parameters were within normal ranges. Neurological deficits completely resolved in 6 of 7 patients. Histopathological diagnosis revealed glioblastoma (WHO°IV) in both patients who had suffered from postoperative re-bleeding. Wound healing disturbances requiring surgical revision occurred in 4 patients (2.5%). A histopathological diagnosis was established in 149 patients (93.7%).

## 4. Discussion

Stereotactic biopsy is considered a very safe and efficient procedure in establishing a diagnosis to guide further treatment of patients with brain lesions [1,4]. Nevertheless, procedure-related risks are potentially life-threatening and furthermore, patients in need of stereotactic brain biopsy often suffer from severe comorbidities. Johnson et al have recently reviewed 3523 cases of stereotactic brain biopsies and found an in-hospital mortality rate of 3.5% [5]. The presence of coagulopathy has to be identified in patients undergoing surgical procedures as impaired haemostasis can lead to an increased bleeding tendency. Intracranial haemorrhage can have devastating effects as even small hematomas may cause significant neurological damage if they are located within the central nervous system. Chen et al. reviewed 299 patients who underwent stereotactic brain procedures and found a symptomatic haemorrhage rate of 4.35% [6]. In a further study on 150 consecutive patients who underwent CT four hours after stereotactic biopsy, the overall haemorrhage rate was 4.7% while only 1.4% had symptomatic haemorrhage with corresponding clinical symptoms [7].

There is only little evidence regarding preoperative assessment of haemostatic risks in patients undergoing stereotactic brain biopsies. Intense debate has emerged whether routine coagulation tests should be carried out prior to elective surgical procedures [8,9]. These tests commonly include assessment of PT and aPTT. Both tests were originally developed to aid in the diagnosis of inherited bleeding disorders but were not intended as a screening tool for coagulopathy. With regard to elective neurosurgical procedures, Dützmann et al. reviewed the medical records of 4310 patients with specific focus on PT and rates of postoperative haemorrhage [10]. Only five patients (0.1%) had unexpectedly increased values of PT and of these patients, none suffered from postoperative haemorrhage. The authors concluded that PT assessment is of limited value as a screening tool prior to elective neurosurgical procedures. These findings were supported by Almesbah et al. who found that routine coagulation tests prior to elective neurosurgery in 355 children did not affect the progression of scheduled procedures [11]. In our series, no patient had coagulation parameters outside normal range values. Patients who developed symptomatic haemorrhage had normal values of PT and aPTT (Table 2). Despite limited patient numbers, our findings are in accordance with previous studies and suggest that PT and aPTT are of limited value in the assessment of haemostasis in patients undergoing stereotactic brain biopsies.

Thrombocytopenia has been associated with an increased risk of intracranial haemorrhage in cases of traumatic brain injury and intracerebral haemorrhage [12]. In a study on 500 consecutive patients undergoing stereotactic brain biopsy intracranial haemorrhage was present in 8% of patients undergoing serial postoperative CT imaging [13]. This risk steadily increased as platelet levels fell below 150 $10^3$ μ/L. A study on intracranial meningioma resection revealed that postoperative thrombocytopenia was a risk factor for the development of postoperative hematoma [14]. It seems reasonable to rule out thrombocytopenia through laboratory complete blood count prior to stereotactic brain biopsy. Importantly, complete blood count rules out thrombocytopenia but it does not characterise platelet function. Various reasons can cause platelet function such as antiplatelet medication, corticosteroids, non-steroidal anti-inflammatory drugs (NSAID) or inherited platelet disorders. Antiplatelet medication and NSAID were identified as the most commonly associated risk factors for postoperative hematomas following 6668 neurosurgical procedures [15]. We have recently introduced point-of-care testing of platelet activity in neurosurgical emergency patients at our institution to characterise antiplatelet activity in respective patients [16]. We did not

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