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Assessment of the effect of short-term factors on surgical treatments for hypertensive intracerebral haemorrhage

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ABSTRACT

Background: Hypertension is the most common cause of intracerebral haemorrhages (ICHs), yet the short-term impact factors associated with hypertensive intracerebral haemorrhages (HICHs) in patients who undergo different surgical treatments are still unknown.
Materials and methods: All consecutive patients with acute HICHs admitted to our hospital from January 2012 to March 2015 were enrolled in the study. Patients were either randomly divided or assigned according to their family's preference into three groups (those undergoing minimally invasive aspiration, keyhole craniotomy or haematoma aspiration with extended pterional and decompressive craniotomy). Patients' information and clinical characteristics were collected to identify risk factors influencing the short-term effects of the procedures.
Results: There were significant differences among the groups: haematoma aspiration with extended pterional and decompressive craniotomy was the optimal method, resulting in fewer complications, higher Glasgow Outcome Scale (GOS) scores and better short-term outcomes. Surgical treatment, Glasgow Coma Scale (GCS) scores, haemorrhage volume and degree of midline shift were risk factors for the short-term effects associated with HICH.
Conclusions: Haematoma aspiration with extended pterional and decompressive craniotomy is suitable for treating HICH patients. Surgical treatment, GCS score, haemorrhage volume and degree of midline shift influence the short-term effects observed following HICH surgery.

1. Introduction

Hypertension is the most significant risk factor for a spontaneous intracerebral haemorrhage (ICH). Approximately 40% of patients with an ICH die within 30 days, and most survivors endure severe disabilities [1,2]. The prognosis of standardized treatments of hypertensive intracerebral haemorrhages (HICHs) shows that standardized surgical treatments are superior to standardized medications [3,4]. However, many surgical treatments for HICHs are available, such as minimally invasive aspiration, keyhole craniotomy and haematoma aspiration with extended pterional and decompressive craniotomy. Physicians have proposed that different surgical treatments have different impacts on patient outcomes, and the effectiveness of these treatments remains under dispute [5]. Therefore, we conducted a clinical trial involving 296 HICH patients to analyse relationships between the surgical treatments, clinical characteristics of patients and effects one month after surgery.

2. Materials and methods

2.1. Inclusion and exclusion criteria

Two hundred ninety-six patients who underwent surgery for an acute HICH in the Neurosurgery Department of our hospital between January 2012 and March 2015 were enrolled. The inclu-

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sion criteria for the patients in this study were as follows: (1) history of hypertension; (2) diagnosed with HICH for the first time [6], as well as meeting the diagnostic criteria for severe HICH (i.e., a Glasgow Coma Scale (GCS) score ≤8 andundergoing surgery within 24 h after symptom onset); and (3) CT examination showing a haemorrhage from the parenchyma, basal ganglia, and internal capsule or the thalamus, with or without the involvement of the brain ventricle, and >40 ml of bleeding, which was calculated according to the Duotian equation. Exclusion criteria included the following: (1) a haemorrhage in the cerebellum and brainstem; (2) cerebral aneurysm, vascular malformation, and haemorrhage; and (3) terminal brain hernia, serious general disease or visceral disease, and patients with operative contraindications.

2.2. Surgical treatment methods

2.2.1. Haemorrhage puncture and aspiration

Based on the CT scan, we drilled into the haematoma in the thickest part of the skull with local anaesthesia and placed a drainage tube in the centre of the haematoma. The haematoma was aspirated repeatedly using a 20 ml saline injector while keeping the drainage tube in place. CT was used to review the residual haematoma of HICH patients, and if the volume was <20 ml, drainage took approximately 1–2 d. In cases where the drainage volume was ≥20 ml, 40000 of urokinase was injected in the drainage tube, and the tube clip was closed for 2 h, twice per day. Additionally, we performed dynamic cerebral CT examinations until the haematoma volume was <20 ml and then removed the drainage tube.

2.2.2. Keyhole craniotomy

(1) A longitudinal incision approximately 6–8 cm in length was made at the thickest part in the haematoma with patients under general anaesthesia. (2) A bone window approximately 3–4 cm in diameter was created, and (3) a cross shaped cut was made to open the dura mater. (4) A needle puncture was performed to locate and clear the cortical haematoma under a microscope. (5) Then, haemostasis was confirmed, and the bone flap was replaced. (6) Finally, a drainage tube was placed, and the skull was closed. If hydrocephalus was present, we performed external ventricular drainage.

2.2.3. Haematoma aspiration with extended pterional and decompressive craniotomy

(1) A question-mark incision was made in the frontoparietal area with patients under general anaesthesia, using an extended pterion operative approach. The bone window was approximately 10 cm × 12 cm. (2) A cross shaped incision was made at the position nearest to the haematoma in the dura, and the haematoma was depressurized. The dura mater disc was expanded from the sinus puncture to the cortical cut to form a fistula approximately 1–1.5 cm in diameter, and (3) a microscope was put in place and adjusted to a 4× magnification to visualize the site while clearing the haematoma, with the power of the bipolar electrocoagulation unit set at 10 W–15 W. If there was no bleeding in the cranial cavity, we repaired the dura using an artificial meninx. (4) Finally, the bone flap was removed, and a drainage tube was placed to close the cranium. If hydrocephalus was present, we performed external ventricular drainage.

2.3. Postoperative management

All patients underwent a head CT scan within 1 h after the operation, and their vital signs were closely monitored. Oxygen was administered, keeping the respiratory tract unobstructed, regularly turning the patient onto their back, massaging the body, and exercising the joints to prevent pressure ulcers and deep venous thromboses. In addition, we controlled the blood pressure and blood sugar levels of the patients, lowered their intracranial pressure, prevented and treated infections and complications, maintained a stable internal environment, and provided thorough nutritional support. The cranial CT scans of the patients were reviewed, and delayed haematomas were treated in a timely manner.

2.4. Complications and evaluation of treatment effects

We monitored patients for five major complications following the HICH operation: intracranial infection, stress ulcer, pulmonary infection, cerebral infarction, and postoperative haemorrhage. We rated each patient's status by classifying them into one of five categories using their GOS scores after the operation during a one-month follow-up period. A GOS score of 4–5 indicates a favourable effect of the treatment; a GOS score of 1–3 indicates an unfavourable effect [7]. The primary outcome was the dichotomized prognosis-based treatment effect (favourable or unfavourable) based on Extended Glasgow Outcome Scale (GOSE) scores 6 months after the surgical treatment randomization.

2.5. Statistical analysis

SPSS 19.0 software was used for statistical analyses. ANOVA was used to test for differences in quantitative data. For qualitative data, we used a χ^2 test. Logistic regression analysis (forward stepwise (conditional)) was used to analyse risk factors for the short-term effects observed following HICH operations. Values of $P \leq 0.05$ (two-tailed) were considered significant.

3. Results

3.1. General characteristics of the patients

A total of 296 HICH patients (195 men, 101 women; mean age, 54.8 ± 9.5 y (range: 37–72 y)) treated via surgery in the early period after the occurrence of the haemorrhage were included in our study. Mean systolic pressure before the operation was 172.7 ± 20.1 mmHg (143–247 mmHg). A total of 117 patients had GCS scores between 3 and 5, and 179 patients had GCS scores of 6–8. According to the Duotian equation, 186 patients had a 40- to 80-ml haemorrhage volume, and 110 patients had a haemorrhage volume greater than 80 ml. Forty-nine patients had a midline shift of 0–0.5 cm, 88 patients had a midline shift of 0.6–1 cm, 103 patients had a midline shift of 1.1–1.5 cm, and 56 patients had a midline shift of >1.5 cm.

All of the patients had surgical indications for craniotomy-based evacuation of their haemorrhage, and operations were performed within 7 h (32 cases) or between 7 and 24 h (264 cases) after cerebral haemorrhage. Because the legal proxies of 53 patients refused to sign the "operation agreement" for a craniotomy, these patients underwent haematoma puncture and aspiration (group I) based on the family's preference. The other 243 patients were divided into two groups via random assignments: group II included 116 patients who underwent keyhole craniotomy; group III included 127 patients who underwent haematoma aspiration with extended pterional and decompressive craniotomy. The general characteristics of the patients are provided in Table 1. As shown in the table, clinical characteristics were not significantly different between the groups.