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Original Article

Endoscopic hematoma evacuation in patients with spontaneous supratentorial intracerebral hemorrhage

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Abstract

Background: Surgical evacuation of spontaneous supratentorial intracerebral hemorrhage (ICH) is controversial because the traditional surgical approach sometimes causes further brain injury. The introduction of the neuroendoscope has brought with it the new idea of minimal invasiveness, which may improve the surgical results of ICH.
Methods: Twenty-one patients with spontaneous supratentorial ICH underwent endoscopic hematoma evacuation between December 2010 and January 2012. Safe entry points could be Kocher's, Keen's, or Frazier's point, depending on the locations of the hemorrhages. The surgical steps were as follows: (1) cortical incision and dilation of the channel; (2) introduction of the transparent sheath; (3) gushing out of the hematoma under high intracranial pressure; (4) changing the angle of the transparent sheath, endoscope, and suction tip to remove residual hematoma; and (5) paving a layer of hemostatic agents after hematoma removal.
Results: The median operative time was 120 minutes (range: 90–190 minutes), and the median blood loss was 160 mL (range: 50–300 mL). The median duration of intensive care unit stay was 6 days (range: 2–18 days). The median hematoma evacuation ratio was 90% (range: 60–99%). Two patients had rebleeding events, and the mortality rate was 9.5% ($n = 2/21$). The median Glasgow Coma Scale score improved from 8 to 11 within 1 week after surgery, and the median Glasgow Outcome Scale score was 3 after 6 months and 12 months follow-up.
Conclusion: With the introduction of the minimally invasive techniques and the evolution of the neuroendoscope and hemostatic agents, the median operative time and blood loss have been significantly decreased. Although the hematoma evacuation rates were similar between the endoscope (90%) and craniotomy (85%) groups, the median intensive care unit stay was decreased from 11 days to 6 days due to reduced surgical invasiveness. This represents an important advancement in treating spontaneous supratentorial ICH, and provides a measured preview of the promising results that can be expected in the future.

Keywords: Glasgow coma scale; Glasgow outcome scale; Neuroendoscopy; spontaneous intracerebral hemorrhage; surgical evacuation

1. Introduction

Spontaneous supratentorial intracerebral hemorrhage (ICH) affects ~20 in 100,000 people annually and the mortality is >40%.[1] For the most part, survivors are left handicapped. Although the clinical outcome is mainly determined by the patient's initial presentation, early surgical intervention is crucial and urgent in selected patients. In the previous

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literature, patients with hematomas ≤1 cm from the cortical surface were more likely to have a favorable outcome from early surgery than those with deep hematomas.[2] However, with the evolution of the neuroendoscope and hemostatic agents, the surgical evacuation of ICH in deep location is now safer and less invasive than before. Here, we present our series of patients with spontaneous supratentorial ICH who underwent endoscopic hematoma evacuation. The surgical indication, timing, surgical technique, and long-term results are discussed.

2. Methods

2.1. Patient population

A consecutive series of 21 patients with spontaneous supratentorial ICH underwent endoscopic hematoma evacuation between December 2010 and January 2012. Without randomizing the grouping, another 24 patients with spontaneous supratentorial ICH underwent hematoma evacuation by craniotomy were also included for comparison. These patients' general data, and their symptoms and signs were retrospectively collected. Patients and their families who enrolled in this study were informed retrospectively, and all of them agreed to the use of clinical parameters via a process of de-identification. All patients underwent brain computed tomography (CT) to localize the ICH. CT angiography or a contrast CT checkup was used for some patients with ICH in unusual locations to exclude the possibility of abnormal arteriovenous malformations, fistulas, aneurysms, or other vascular lesions. Coagulation functions including bleeding time, prothrombin time, activated partial thromboplastin time, and platelet count were also evaluated to avoid intraoperative bleeding. Other coagulation tests including protein C, protein S, fibrinogen, platelet function, D-dimer, and antiphospholipid antibodies are used on a case-by-case basis. In an earlier case, a thin-cut CT scan was arranged for intraoperative navigation.

The inclusion criteria were consciousness disturbance with one of the following: (1) a putamen ICH with hematoma volume > 30 mL; or (2) subcortical hemorrhage > 30 mL with a significant mass effect (midline shift > 5 mm and sulcus effacement). The exclusion criteria were tumor, trauma, vascular lesions, or other intracranial lesions. End-stage renal disease or Child Class C liver cirrhosis was not a contraindication for surgical evacuation. However, a neurosurgeon had requested that the coagulopathy status be corrected before the operation. According to the basic coagulation tests, the patients who had low platelet counts proceeded with platelet infusion, and FFP (Fresh Frozen Plasma) and vitamin K were prescribed to patients who had abnormal international normalized ratio. For patients with antiplatelet medications (e.g., aspirin or clopidogrel), platelet infusion was necessary even though the patients had normal platelet counts, prothrombin time, and activated partial thromboplastin time. If the coagulopathy of the patients could not be corrected, we explained the surgical risks to the family and treated the patients conservatively.

2.2. Entry point selection and patient preparation

The entry point was determined by the location of the hemorrhage. The entry point could be Kocher's point (Fig. 1A), Keen's point (Fig. 1B), or Frazier's point (Fig. 1C); similar to the entry points of ventriculostomy. The only difference was the trajectory. If the patient had putamen ICH, the Kocher's point was the best point of entry, and the trajectory was lateral to that of ventriculostomy. If the patient had thalamic ICH with temporal expansion, the Keen's point location of entry might have been the best choice. Frazier's point was suitable for occipital extension of the ICH. To monitor intracranial pressure (ICP), contralateral ventriculostomy for ventricular catheter placement was performed in all patients with ICH. Mayfield head fixation for navigation was used in some of our cases, but it was not necessary for all patients. For patients who had ICH in a superficial location, or who had larger ICH for puncture, it was not necessary to fix their heads. The monitor and the holder of the endoscope were placed on the opposite side of the patient's chest.

2.3. Endoscopic hematoma evacuation

After undergoing anesthesia, the patient was put in the supine or prone position, and a linear scalp incision (~5 cm) was then made. A 2.5–3-cm burr hole was created. After tenting the dura, it was opened in a U shape. A 1-cm cortical incision with bipolar cauterization was made, and the ventricular catheter with a sutured glove (Fig. 2B) was inserted. The glove was ballooned, and the entry tract was created. A transparent plastic sheath (ViewSite Brain Access System, Vycor Medical Inc., Bohemia, NY, USA) was then placed (Fig. 2D). After establishing a channel, the endoscope was introduced by hand into the space that was created by the hematoma. Most hematomas may gush out due to high pressure, so we applied a 37-mm 0° rod-lens endoscope (18 cm in length: KARL STORZ GmbH & Co. KG – Tuttlingen, Germany) to aspirate the residual hematoma.

There are three methods to aspirate a hematoma in an extreme angle corner: (1) 30° and 45° rod-lens endoscope (Fig. 2A); (2) angled suction (either anterior or posterior angled suction with a 5-mm, 7-mm, or 10-mm diameter, Fig. 2C); and (3) rotation manipulation of the sheath within the brain parenchyma. The transparent sheath provides excellent visualization: the deepest part of the hematoma should be removed first, and the sheath withdrawn gradually, facilitating the pushing of the residual part of the hematoma into the tip of the sheath. Most of the time, the surgeon can hold the endoscope in one hand, and aspirate the hematoma by smooth-tip suction with the other hand. In addition, a suction adaptor can be used for rapid adjustment of suction power (Fig. 2E). If there is only oozing without active bleeders, the oozing can be stopped with hemostatic agents. If an active bleeder needs cauterization, the surgeon may use bipolar forceps with the endoscope held by an assistant or holder. In our experience, hemostasis in typical hypertensive ICH can be achieved by hemostatic agents (such as FloSeal Hemostatic