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Case Report

The removal of brainstem hemorrhages (BH) using the whole-course, endoscopic retrosigmoid approach

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Abstract: Background and importance: Brainstem hemorrhage (BH) is a dangerous disorder with a poor prognosis. BH is difficult to access surgically due to the complex construction of the brainstem. We present a novel technique for the removal of a brainstem hemorrhage. Clinical presentation: A 59-year-old coma patient was admitted to our hospital with bilateral anisocoria, 4 mm diameter on the left side and 2 mm on the right side and no light reflex. A CT image revealed a 15 ml acute hematoma in the pons. We discussed with his guardian the risks of a surgical removal and conservative management. His guardian decided that he should undergo a surgical removal of the brainstem hemorrhage. Results: The patient underwent a whole course endoscopic retrosigmoid approach for the removal of his brainstem hemorrhage. A total removal was achieved. After the surgery, the patient's pupils returned to normal and were isometric. Ventilator and endotracheal intubation were stopped after two weeks and the patient woke gradually. He is currently in a routine, six month follow up and is gradually returning to normal. Conclusion: We report the successful and total removal of a BH using the whole-course endoscopic retrosigmoid approach. This patient avoided death and has a chance of a good quality of life after the surgical removal with minimal surgical morbidity. Technological advances in the whole-course endoscopic retrosigmoid approach for BH removal have provided access to anterior and anterolateral lesions of the brainstem previously requiring more invasive approaches.

Keywords: Endoscopic, endoscopic retrosigmoid approach, brainstem hemorrhage (BH), brainstem, pontine hemorrhage

Introduction

Patients with acute hypertensive brainstem hemorrhage often succumb quickly to a deep coma, often resulting in brainstem dysfunction and failure with a high mortality rate [1]. In the past, conservative treatment was adopted to ameliorate the disorder, so only a small number of cases were chosen for surgery. The clinical effects of hypertensive brainstem hemorrhages are significant, regardless of the treatment method. The mortality rates reported in the literature are generally higher than 60%. At present, the effects of treating the disorder are not ideal, and many doctors don't want to be involved in the treatment of the disease.

Despite new developments in microscopic navigation technology, which can be used in the surgical treatment of brainstem hemorrhage, due to the depth of the brainstem and its complicated structure, there is a limited field of vision. Brain tissue can be damaged by pulling on tissue because of the need to remove more parts to enlarge the visual field [2, 3]. In recent years, the development of neural endoscopic technology has changed the traditional scope of surgical techniques and the train of thought in the medical community. Given that traditional surgery has a high risk of leaving patients with microsurgery injury due to a poor visual field, it was hypothesized that neural endoscopy could be used to resolve this. After the development of neural endoscopic techniques such as nasal endoscopy and ventricle mirror, several groups put forward the concept of the whole endoscope era [4-6]. On the basis of neural endoscopic surgery, we used neural endoscopy to remove the brainstem hemorrhage. We think neural endoscopic techniques are advantageous in brainstem hemorrhage removal, and the evidence for this is provided by the following technical report.

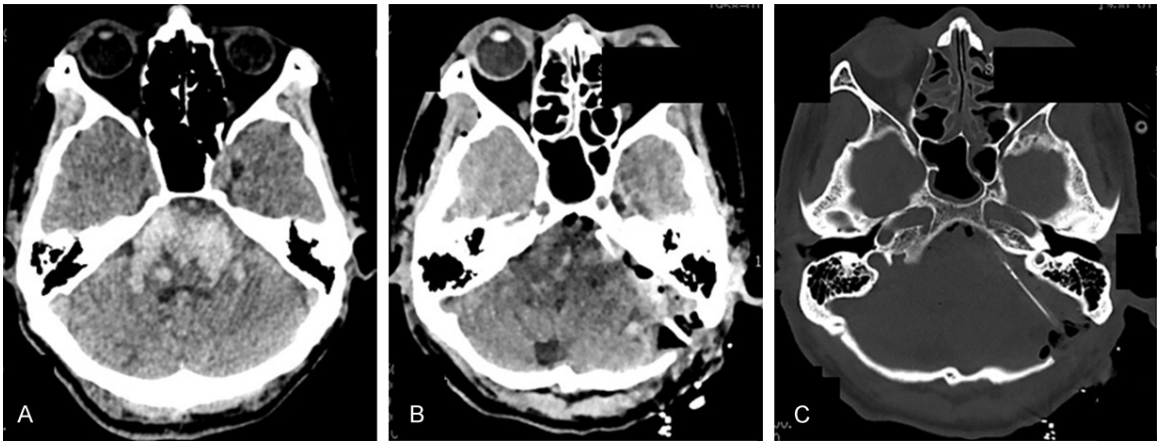

Figure 1. A: Preoperative CT demonstrated evidence of a brainstem hemorrhage; B, C: Complete remove of the hemorrhage was achieved as evidenced by post op CT.

Clinical presentation

Presentation

A 59-year-old coma patient was admitted to our hospital with bilateral anisocoria, 4 mm diameter on the left side, 2 mm on the right side and with no light reflex. A CT scan revealed a 15 ml acute hematoma in the pons (**Figure 1A**). We discussed with his guardian the risks of surgical removal and conservative management. His guardian decided he should undergo a surgical removal of the brainstem hemorrhage.

Patients and methods

Ethics approval and consent to participate

This research was approved by the ethics committee of our University. Informed consent was obtained, and this investigation was conducted according to the principles expressed in the Declaration of Helsinki.

Surgical procedure

Multiple surgical approaches were discussed, the most seriously considered of which was the retrosigmoid approach. It was decided that this technique should be used because of the BH location in the ventral area of the pontine. After full preparation, we used the whole-course endoscopic retrosigmoid approach. After the induction of general endotracheal anesthesia, the patient was positioned in a lateral orientation with the head held in the 3-point Mayfield fixation. His upper body was angled up at 20-30 degrees to reduce venous pressure and bleeding. The patient's head was slightly flexed with the shoulders open to allow for a more direct approach to the pillow neck. The scalp was cut and fixed. A 1.5-2 cm range window was opened using a lamina rongeur and abrasive drilling (**Figure 1C**), and it appeared to confirm the turning point of the transverse sinus and sigmoid sinus, and the medial margin of the superior sigmoid sinus. A section was partly cut open at the dura mater, causing the release of cerebrospinal fluid. After the brain blood pressure drops, a cut was made to the rest of the dura. After the cerebellar tissue pressure fell and collapsed, the separation of the lateral part of the cerebellum interface was achieved and a piece of cotton was applied (**Figure 2A**). A 2 cm × 5 cm rubber glove leather cutting was placed upon the piece of cotton, and a bipolar attractor was used to pull the rubber piece and gradually reveal the cerebellum interface (**Figure 2B**). Using a 0° fixed arm endoscope, and gradually moving from the separation of the boundary in the direction of the brainstem, the surface of the acoustic nerve and arachnoid was located (**Figure 2C**, **2D**). Next, the arachnoid was separated and released, and the hemorrhagic cerebrospinal fluid was released. The bleeding area was determined according to imaging data and anatomical positioning, and with the neural endoscopic identification (**Figure 3A**, **3B**). Bleeding can be characterized by local uplift shape and color change. Finally, the removal of hematoma was performed at this point; if the bleeding hematoma partly breaks into the cerebellopontine angle, the hematoma can be removed from this breach (**Figure 3C**, **3D**).

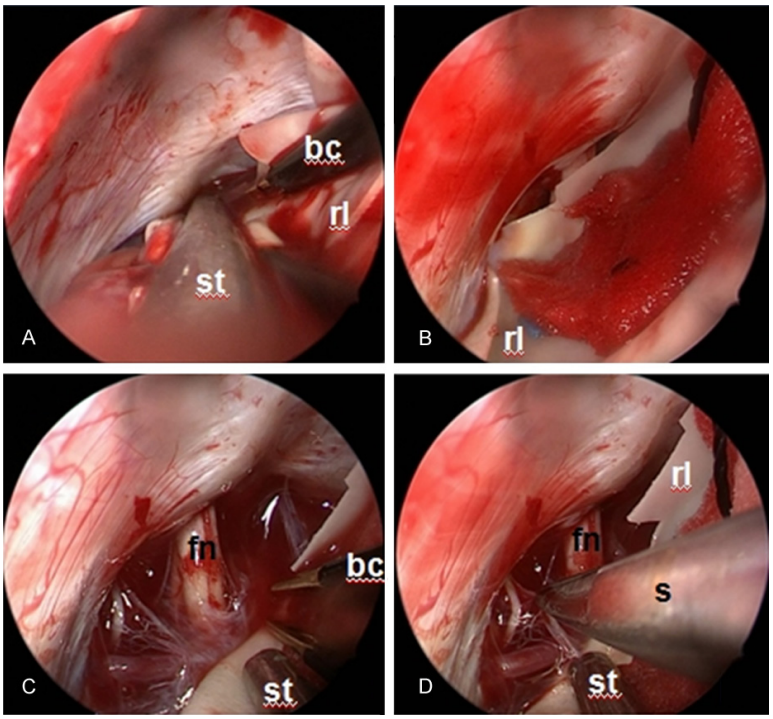

Figure 2. A: Intraoperative neuroendoscopy was placed and the cerebrospinal fluid was released; B: The space was expanding; C: Facial nerve and the arachnoid were found; D: The arachnoid was opened and the facial nerve was released. (st = suction tube; bc = bipolar coagulation; rl = rubber glove leather; s = scissors; fn = facial nerve; h = hematoma; cp = cotton piece).

Results

The patient underwent a whole course endoscopic retrosigmoid approach for the removal of a brainstem hemorrhage. Immediate post-op CT displayed the trans-cerebellar medullary fissure surgical corridor and expected post-operative changes, with the hematoma successfully removed, and no evidence of acute hematoma or infarct (**Figure 1B**, **1C**). A total removal was achieved. After the surgery, the patient's pupils returned to normal and were isometric. Ventilator and endotracheal intubation were stopped after two weeks. The patient woke gradually. He is currently in a routine, six month follow up and is gradually returning to normal.

Discussion

Brainstem hemorrhage (BH) accounts for about 7%-10% of all cerebral hemorrhage, with a total mortality rate of 40%-50% [7]. Brainstem hemorrhage has a low incidence but a high morbidity and a high mortality. Surgical treatment for brainstem hemorrhage is difficult and carries a high risk, but its value is limited, so priority is often given to internal medicine and conservative treatment. For surgical therapy, a variety of methods have been conducted, such as stereotactic hematoma puncture drainage [8]. In recent years, along with the progress of the microsurgical techniques and equipment, the exploration of brainstem hemorrhage surgical treatment has developed rapidly.

One of the authors of this report studied skull base tumors at an early career stage, so he is familiar with the microdissection of brainstem areas and has also mastered many brainstem tumor operation skills. On the basis of these skills, the author carried out the primary microsurgery treatment of the hypertensive brainstem hemorrhage, and during our research process we found that the curative effect of brainstem hemorrhage treatment is in fact not as bad as earlier studies indicate, and many patients can be treated successfully. In addition, from 2009 to now, the author has conducted a neuroendoscopic endonasal approach for the surgical treatment of pituitary adenoma and has also conducted neuroendoscopic treatment of hypertensive supratentorial intracerebral hemorrhage, obtaining much experience [9]. On this basis, we conducted neuroendoscopic treatment of a brainstem hemorrhage using exploration, and we found the technology for brainstem hemorrhage workable, especially after implementing some specific recent advancements.

We adopted the endoscopic retrosigmoid approach in the treatment of this patient and verified that the operation is practical. Its advantages are a small amount of tissue damage, it's in accordance with the principle of minimally-invasive neurosurgery; it can expand the surgical field and the observable range under fixed angle endoscopy, a wide angle can achieve far more than can be achieved with microscope images, so the hematoma cavity can be easily observed, and the hemorrhage can be easily located, and further, bipolar electric coagulation can be used at small sites to

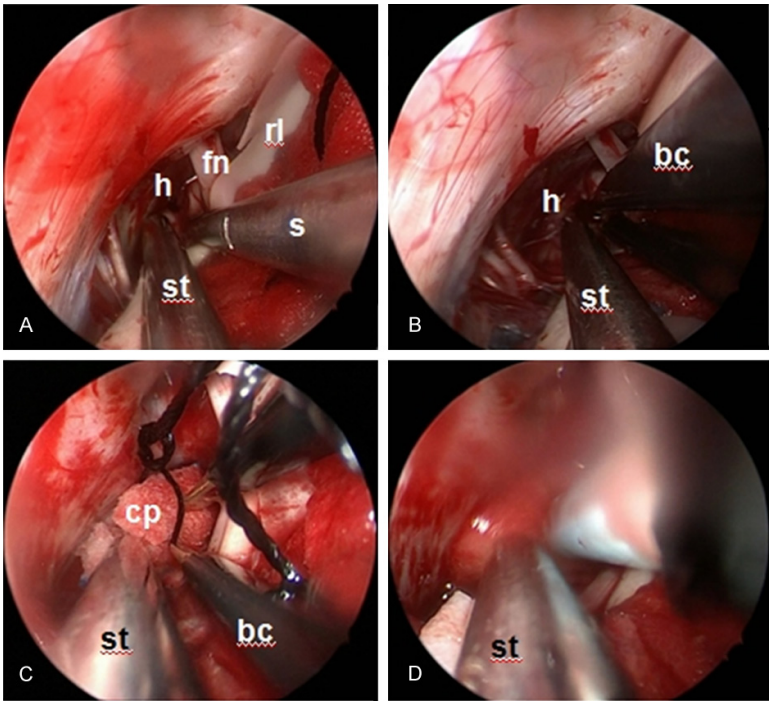

Figure 3. A: The location of the hematoma was found during the operation; B: Opening the hematoma cavity and the removal of the hematoma; C: The hematoma cavity is compressed to stop the bleeding with a piece of cotton after the removal of the hematoma; D: Looking straight down into the drainage tube. (st = suction tube; bc = bipolar coagulation; rl = rubber glove leather; s = scissors; fn = facial nerve; h = hematoma; cp = piece of cotton).

stop the bleeding completely, reducing the incidence of bleeding, and it is possible to intraoperatively look straight down into the drainage tube, and good lighting conditions enable a close view of the lesions and a clear operative field, avoiding blindness during the operation in important functional areas and lowering the risk of damage to the vasculature. It is a simplified operation, and less brain retraction leads to a shorter operation time.

However, the whole endoscopic retrosigmoid approach also has its own limitations, such as: nerve endoscopy provides a 2-D image, which can easily lead to misjudging the depth and size of the lesion followed by incorrect manipulation; the space is narrow and available equipment for the operation is limited; endoscopy provides a front view, but caution is required for carefully operating behind the line and to the side, so frequent endoscopic lateral movement must be avoided in order to reduce iatrogenic brain contusion. With the endoscopic removal of a hematoma, a very accurate preoperative localization of hematoma is required, and brain damage can occur due to inaccuracies.

In addition, in order to ensure the operation goes smoothly, we think the following key points of the operation are important intraoperatively: 1. Anesthesia needs to be kept at a constant, controlled hypotension level, which is advantageous to reduce intraoperative bleeding and reduce intracranial pressure, and it helps to guarantee the cerebellum will collapse, leaving a good amount of operating space. 2. The removal of the hematoma under direct endoscopy, maintained thorough homeostasis, postoperative residual hematoma, which releases thrombin, RBC breakdown products, cytokines, and other toxic substances can induce secondary heavy brain edema [10, 11], but for the hematoma of the brainstem area there is no requirement for excessive importune hematoma removal, in case of injury to normal brainstem tissue. 3. The use of the rubber pieces intraoperatively protects the surface of the cerebellum, avoiding excessive damage to the cerebellum surface by the endoscope and other equipment. 4. We gently washed several times after noticing no bleeding under the endoscope, in order to - as far as possible - flush out the hemorrhagic fluid residue or the blood clots around the brainstem. 5. Intraoperatively looking straight down into the drainage tube at the hematoma clearance, one can ensure timely cerebrospinal fluid circulation, reducing the hematoma breakdown products that can lead to brain damage and in turn reducing the occurrence of vasospasms and complications with obstructive hydrocephalus and late communicating hydrocephalus [12]. 6 The surgeon must be familiar with intracranial anatomy to avoid damage to brain structural tissue, including the petrous vein, as petrous vein injury is a common cause of bleeding in CPA surgery [13].

The whole course endoscopic retrosigmoid approach has high operational requirements, including skilled neural endoscopic physicians

who have experience in endoscopic surgery. The patient was operated on by skilled neuroendoscopic physicians, who obtained a satisfactory therapeutic effect. We believe that for brainstem hemorrhage, the whole course endoscopic retrosigmoid approach is a good method by which to obtain a satisfactory therapeutic effect.

Conclusions

We report the successful total removal of a BH via a whole course endoscopic retrosigmoid approach. This patient avoided death and received a chance to live after the surgical removal with minimal surgical morbidity. Technological advances in the whole-course endoscopic retrosigmoid approach have provided access to anterior and anterolateral lesions of the brainstem that previously required more invasive approaches.

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Written informed consent was obtained from the patient for the publication of this case report and any accompanying images. A copy of the written consent is available for review by the editor-in-chief of this journal.

Disclosure of conflict of interest

None.

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