doi: 10.2176/jns-nmc.2023-0301

NMC Case Report Journal 11, 141-144, 2024

Endoscopic Cerebellar Necrosectomy for Space-occupying Cerebellar Infarction: A Case Report

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Abstract

Suboccipital decompressive craniectomy with or without resection of necrosis is the preferred treatment for space-occupying cerebellar infarctions with neurological deterioration due to brainstem compression and obstructive hydrocephalus. We herein present our experience with treating space-occupying cerebellar infarctions successfully using endoscopic necrosectomy. A total of 27 patients were admitted to our hospital due to cerebellar infarctions between April 2021 and November 2023. Four patients required surgical interventions due to a drop in consciousness level or compression of the fourth ventricle and brainstem with acute hydrocephalus confirmed by a computed tomography (CT) scan. Three patients were performed endoscopic necrosectomy through a burr hole in a supine-lateral position. Removing most of the necrotic tissue was possible, resulting in early decompression of the fourth ventricle and brainstem. Endoscopic necrosectomy is less invasive than suboccipital decompressive craniectomy. An endoscopic necrosectomy can be performed for patients with unstable health conditions in a supine-lateral position. Therefore, endoscopic necrosectomy might be an effective method for treating patients with space-occupying cerebellar infarctions and poor general condition, although an objective evaluation of the extent and degree of removal is needed.

Keywords: space-occupying cerebellar infarction, endoscopic surgery, necrosectomy

Introduction

Space-occupying cerebellar infarction (SOCI) is considered a neurosurgical emergency because it causes brainstem compression and obstructive hydrocephalus, resulting in sudden clinical deterioration. It has been reported that mortality rates of cerebellar infarctions are 20%-30%.[1-5] Neurosurgical interventions such as extraventricular drainage (EVD), suboccipital decompressive craniectomy (SDC), SDC with EVD, or SDC with necrosectomy are conducted to prevent brainstem and fourth ventricle compression.[2] The Japanese Guidelines for the Management of Stroke 2021 and the American Heart Association/American Stroke Association guidelines for the management of cerebellar infarction recommend surgical decompression in patients with neurological deterioration despite maximal medical treatment (Class I, Level B evidence);[6,7] however, there is a lack of evidence regarding which type of neurosurgical intervention has a better outcome.[8]

Hernandez-Duran et al. reported in their retrospective, single-center study of 34 consecutive patients with SOCI undergoing necrosectomy via osteoplastic craniotomy that 76% of their patients had good functional outcomes. There was no significant difference in outcomes or deaths between patients undergoing necrosectomy via osteoplastic craniotomy and SDC.[4] They concluded that necrosectomy appears to be a suitable alternative to SDC for SOCI and that endoscopic evacuation is a safe and secure approach for cerebellar hemorrhage and has become a mainstream technique.[9,10] We herein present our cases of SOCI successfully treated using an endoscopic necrosectomy.

Received December 25, 2023; Accepted March 15, 2024

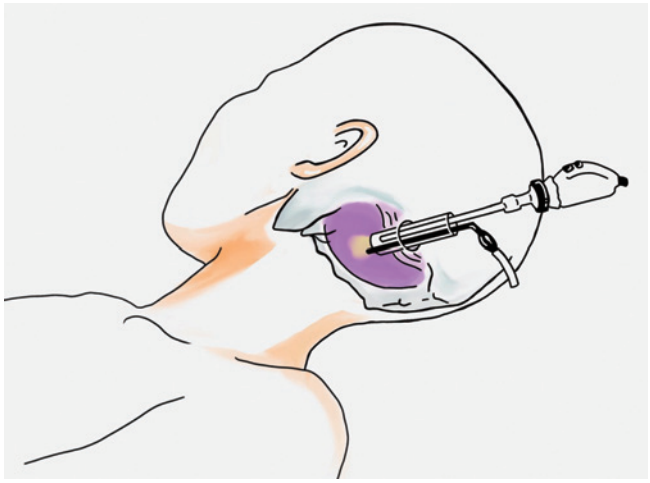

Fig. 1 An illustration showing endoscopic necrosectomy in a supine-lateral position. Through a burr hole, the infarcted cerebellar tissue (purple area) was aspirated using a 2.7-mm-diameter rigid endoscope in a 10-mm-diameter transparent sheath.

Case Report

Patients

A total of 371 patients were admitted to our hospital for treatment of ischemic stroke between April 2021 and November 2023. Of them, 27 patients (7.2%) had cerebellar infarctions: 14 patients had a small cerebellar infarction without mass effect and 13 had moderate to large cerebellar infarctions that required intensive monitoring of the patient's level of consciousness and signs of brainstem compression. Surgical interventions were indicated in four patients due to deterioration of consciousness level or the presence of ventricle and brainstem compression with acute hydrocephalus on computed tomography (CT) scans.

Suboccipital hemicraniectomy with microscopic necrosectomy was performed in the first patient, while endoscopic necrosectomy through a burr hole was performed in the other three patients. Endoscopic necrosectomy was performed following the acquisition of informed consent, which includes a comprehensive explanation of alternative procedures, such as suboccipital decompressive craniectomy.

One of the three patients who underwent endoscopic necrosectomy was on antiplatelet therapy before the operation. Following the procedure, one patient was initiated on antiplatelet therapy, while two were started on anticoagulant therapy.

The local institutional ethics committee retrospectively and prospectively granted approval for endoscopic necrosectomy in cerebellar infarction (approval number: 2023-12). Written informed consent for inclusion in this study was waived, and patients were provided the option to opt out via our institution's website.

Endoscopic necrosectomy

Patients under general anesthesia were positioned supine-lateral with their heads rotated away from the surgical side and fixed in a frame. Using the preoperative images as a guide, we meticulously chose the placement of the burr hole. This hole was selected to facilitate the insertion of the endoscope in order to remove the infarcted cerebellar tissue (Fig. 1). Through a linear incision and the burr hole, the dura was opened, and a 10-mm-diameter transparent sheath (NeuroPort, Olympus Medical Systems, Tokyo, Japan) was inserted. The infarcted cerebellum was aspirated using a 2.7-mm-diameter rigid endoscope (KARL STORZ Endoscopy Japan, Tokyo, Japan) inserted through the sheath. Hemostasis procedures were performed using suction with monopolar coagulation or flexible bipolar forceps. After confirming the hemostasis in the decompressed space filled with artificial cerebrospinal fluid (Otsuka Pharmaceutical Factory, Tokushima, Japan), the dural incision was closed and the wound was sutured in layers. After the operation, a brain CT scan was made immediately to confirm whether the decompression was sufficient or not.

The modified Rankin Scale (mRS) of three patients at discharge was 1, 4, and 4. A case is presented after the ethics committee approval.

Illustrative case

An 82-year-old woman with a medical history of tumor removal for right vestibular schwannoma 30 years ago presented to our hospital with persistent nausea and diaphoresis. She was not on any antithrombotic therapy. Brain MRI showed left cerebellar infarction (Fig. 2A). Chest X-ray and echocardiography showed evidence supporting the diagnosis of chronic heart failure (Fig. 2B). She was admitted under conservative medical treatment with intensive monitoring of her consciousness.

On the day of her admission, her conscious level deteriorated and became comatose at night. An urgent CT showed compression of the fourth ventricle and brainstem with acute hydrocephalus (Fig. 2C and D). Accordingly, an emergency endoscopic necrosectomy was performed and it lasted for 105 min (Fig. 2E, F). The patient's postsurgery recovery was slow. She was put on an anticoagulant medication and transferred to another hospital for further rehabilitation on postop day 43. Her mRS on discharge was 4.

Discussion

Suboccipital decompressive craniectomy is the preferred treatment for patients with SOCI when their neurological symptoms worsen due to compression of the fourth ventricle or brainstem, as long as there is no brainstem infarction.[1,11] Studies have shown that patients with neurological deterioration benefit more from SDC than conservative therapy alone.[11] It is recommended that patients with evidence of raised ICP and imminent deterioration undergo

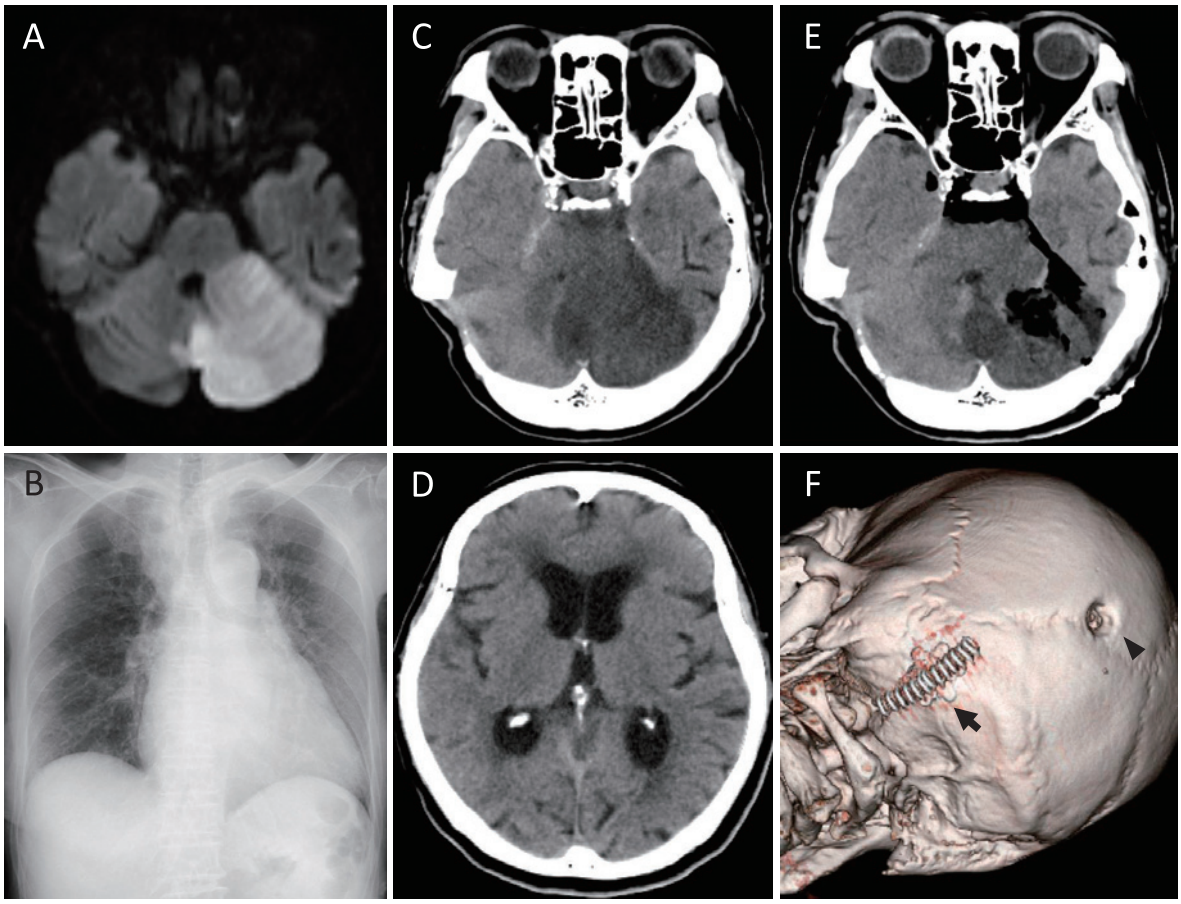

Fig. 2 MRI diffusion-weighted image (A) and chest X-ray (B) on admission showing left cerebellar infarction and signs of chronic heart failure, respectively. CT images on the night of same day show compression of the fourth ventricle and hydrocephalus (C and D). Postendoscopic necrosectomy CT image displays the removal of the infarcted tissue and decompression of the fourth ventricle (E). A 3D-CT image shows the location of the burr holes for the endoscopic necrosectomy (arrow) and for the previous surgery for vestibular schwannoma (arrowhead, F).

neurosurgical intervention.[8] Therefore, monitoring the level of consciousness and new signs of brainstem compression is crucial.[8] To predict the worsening of neurological symptoms, Taylor et al. suggest measuring infarction volume by CT scans and scoring the mass effect in the posterior fossa.[3]

The time from when symptoms begin to when surgery is performed does not significantly impact the outcome.[8] However, a shorter time may result in better functional outcomes.[2] Kim et al. reported that favorable clinical outcomes could be expected after preventive SDC in patients with large infarcts with the absence of brainstem infarction.[12] The same report showed that when the ratio of the volume of cerebellar infarction to the volume of the posterior fossa is between 0.25 and 0.33 on initial or routine follow-up images, it is considered a large cerebellar infarction. Recent studies reported that patients with infarct volumes greater than 6.0 cm^3 and a GCS score between 12 and 15 should consider SDC treatment.[11] These patients tend to have better long-term outcomes than those whose surgery is delayed until their GCS score drops below 11. However, there is a lack of evidence to support early or preventative craniectomies in the absence of clinical or radiological signs of deterioration.[5,8] When patients are clinically stable, surgical therapy is just as effective as conservative management at the time of presentation.[8]

There are conflicting views on whether adding necrosectomy to SDC is advantageous. Hernandez-Duran et al. reported that the outcomes of necrosectomy without decompressive craniectomy were comparable to those achieved with SDC.[4] One meta-analysis found that necrosectomy is linked to lower mortality rates.[2] However, another study reports that necrosectomy does not enhance prognosis.[1] Conversely, a different study advocates for SDC regardless of the presence or absence of necrosectomy.[13]

We conducted a necrosectomy procedure using an endoscope through a single burr hole while the patient was in a supine-lateral position. This particular type of endoscopic necrosectomy is less invasive than the one performed through osteoplastic craniotomy. It is a practical

option for patients who have severe general conditions, such as the case mentioned earlier, and who also have heart failure. This method is also suitable for patients who have limited body positions or require a shorter operation time.

The procedure for conducting endoscopic necrosectomy surgery is similar to that of cerebellar hemorrhage surgery. Intraparenchymal hemorrhage has been managed for many years by removing only the hematoma, without decompressive craniectomy, since the introduction of stereotactic surgical aspiration.[14] Precisely locating a burr hole on the infarcted cerebellum facilitates the straightforward aspiration of necrotic tissue, mirroring the burr hole positioning method employed in cerebral hemorrhage procedures.[15] In our cases, we were able to distinguish between soft necrotic tissue and normal cerebellum. We were able to accurately locate the necrotic tissue by identifying nearby structures such as nerves, petrosal vein, petrous dura, or tentorium. We were able to safely remove it from the cerebellum without causing any harm to the healthy brain tissue. Since there are no clear landmarks within the brain parenchyma, it was important to perform an objective assessment of the amount of removal. In our cases, we confirmed this by conducting a brain CT scan immediately after the procedure. If available, using intraoperative imaging and a surgical navigation system during surgery could be beneficial to identify necrotic tissue and objectively evaluate the extent and degree of removal.[16] Hemostasis was achieved without difficulty and was not affected by the use of antithrombotic medications. This approach facilitated early decompression of the fourth ventricle and brainstem when urgent intervention was required.

The limitations of endoscopic necrosectomy include the possibility of damaging the viable cerebellum, challenges in achieving hemostasis, and the risk of inadequate decompression for the brainstem. Nevertheless, endoscopic necrosectomy may be a viable alternative to SDC in cases of cerebellar infarctions that result in space occupancy.

Conflicts of Interest Disclosure

The authors declare no conflicts of interest (COI). They have completed the online self-reported registration of the COI status to the society.

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