Case Report

Cerebral Venous Sinus Incision for Surgical Thrombectomy Combined with Thrombolysis During Decompressive Craniectomy for Malignant Cerebral Venous Sinus Thrombosis Complicated with Cerebral Hernia

Yan'gang Wang, MMed,* Yang Wang, MMed,† Junjie Zhang, MMed,* Shunli Du, MMed,* and Jiabin Wu, MMed*

For malignant cerebral venous sinus thrombosis (CVST) complicated with cerebral hernia, decompressive craniectomy may be life-saving, and thrombectomy combined with thrombolysis may obtain better outcomes. This report describes an approach performed on 2 patients diagnosed with CVST combined both thrombectomy and thrombolysis with decompressive craniectomy through incising the superior sagittal sinus. The general procedure of the operation is as follows. The anterior part of the superior sagittal sinus was exposed firstly. After cutting the dura matter for decompression, a superior sagittal sinus incision was taken to detect sinus thrombus. In order to facilitate hemostasis during detecting the sagittal sinus, 2 silk sutures were sutured along the incision. The incision was 5 millimeters long approximately along the middle line of the front third of the superior sagittal sinus. A silicone intubation was inserted in the sinus through the incision. Thrombus was seen in the suction tube. At a depth of about 10 cm, while it is difficult to penetrate the tube, we used the gelatin sponge to cover the sinus incision and fixed the suture lines after cross-knotting. The silicone intubation was drawn out through the forehead and connected to external micro pump for injecting anticoagulant drugs, then cut the dura mater into star-shaped and discard bone flap for decompression. Absorbable artificial dura mater was used to repair bilateral dura mater, respectively. At last, connect the catheter to the micro pump for pumping anticoagulant. After operation, the 2 patients received thrombolysis through the catheter placed in the sinus. Both of them recovered well. There was no incision-related bleeding occurred after surgery. Both the patients achieved incredibly good outcomes. For patients with malignant cerebral venous sinus thrombosis, acute cerebral hernia or cerebral hernia tendency, it may be an effective approach combined both thrombectomy and thrombolysis with decompressive craniectomy through incising the superior sagittal sinus.

Key Words: Cerebral veins sinus thrombosis—cerebral hernia—hypercoagulability—surgery

Introduction

For malignant cerebral venous sinus thrombosis (CVST) complicated with cerebral hernia, decompressive craniectomy may be life-saving,[1-4] and thrombectomy combined with thrombolysis before or after the craniotomy may obtain better outcomes.[5-8] But sometimes there are contraindications to imply intravascular intervention[3-5] on patients with malignant intracranial hypertension, as endovascular thrombectomy or thrombolysis is time-consuming and difficult to relieve intracranial hypertension

From the *Department of Neurosurgery, the People's Hospital of Jiaozuo, Jiaozuo, Henan, China; and †Department of Internal Medicine, the Second People's Hospital of Jiaozuo, Jiaozuo, Henan, China.

Received January 14, 2019; revision received February 23, 2019; accepted March 10, 2019.

Address correspondence to Yan'gang Wang, Department of Neurosurgery, Jiaozuo Municipal People's Hospital, Jiaozuo 454000, Henan, China. E-mail: wygsjwk@163.com.

1052-3057/$ - see front matter

https://doi.org/10.1016/j.jstrokecerebrovasdis.2019.03.030

and cerebral hernia, or even make the situation worse.[1-3,8] Then, what can we do? Is there any other way except endovascular thrombectomy or thrombolysis? How about thrombectomy through anterior part of the superior sagittal sinus during decompressive craniectomy? This report describes an approach that combined both thrombectomy and thrombolysis with decompressive craniectomy through incising the superior sagittal sinus. By retrieving concerned literatures in Chinese and English, this surgical thrombectomy and thrombolysis were not reported previously. The surgical procedure of 2 cases diagnosed with malignant CVST complicated with cerebral hernia is described below.

Materials

The first case was a 38-years-old female with "dizziness, vomiting for 2 days and in coma for 3 hours." She was 32 weeks pregnant. During the past 5 months, she was suffering from pyelonephritis and hypertension. Physical examination: Glasgow coma scale (GCS), papilledema, bilateral pupil size (left 3.0 mm, right 4.0 mm), light reaction disappeared. She was in decortical state. The Babinski sign was positive bilaterally. The blood coagulation was abnormal. Brain computed tomography (CT) and magnetic resonance venography (MRV) approved the diagnosis of CVST (Fig 1A-C).

The second case was a 43-year-old female admitted to the hospital for "dizziness for 1 week, weakness of the right leg and loss of consciousness for 1 day." The patient had a history of endometriosis and menorrhagia in the past. One week ago, she underwent curettage treatment in other hospital. Physical examination: coma, GCS 6 points, bilateral pupil size (left 3 mm, right 2 mm), bilateral pupillary photosensitivity, no nystagmus, bilateral Babinski sign positive, and meningeal irritation positive. Inpatient brain CT (Fig 2A) revealed extensive cerebral infarction in the left frontotemporal lobe with hemorrhage, brain edema, and the midline shift right. Filling defect or interruption of superior sagittal sinus and bilateral transverse sinus venous was found by MRV (Fig 2B). She was diagnosed with CVST.

Characters of the 2 case was concluded as follows:[5-7] (1) CVST confirmed by brain magnetic resonance imaging with MRV. (2) Clinical signs of impending herniation, as defined by the presence of unilateral third nerve dysfunction and/or deterioration on the GCS. (3) The deterioration was the result of malignant intracranial hypertension (cerebral mass lesions: venous infarction or brain edema) and not attributable to seizures. Cerebral infarction and hemorrhage occurred in the second patient.

There are no standard surgical indications at present. We sum up the surgical indication and selection criteria of

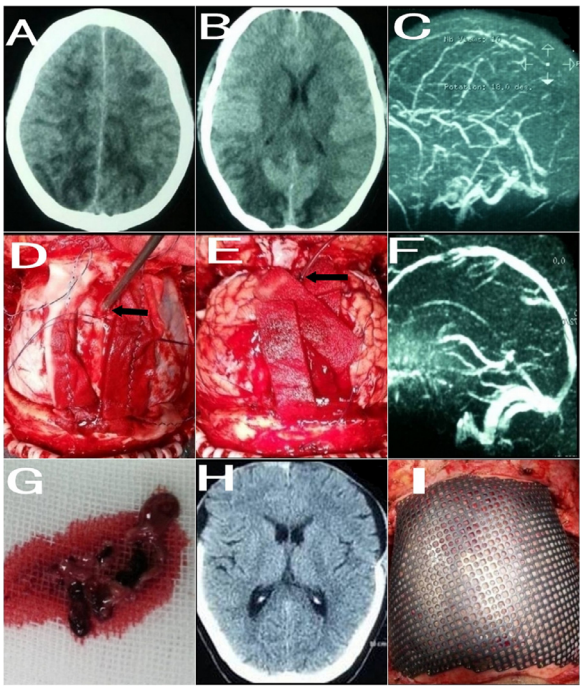

Figure 1. *Preoperative images, intraoperative findings, and postoperative imagines of the first patient. (A) bilateral centrum semiovale at CT before operation; (B) bilateral ventricle and basal ganglia area of the thalamus before operation; (C) preoperative MRV; (D) superior sagittal sinus incision in operation; suction can be inserted into the sinus incision (black arrow); (E) a tube has been inserted into the sinus and fixed with the incision (black arrow); (F)1 day postoperative MRV; (G) intraoperative thrombus in the sagittal sinus; (H) head CT of 3 months after operation; (I) 3 months after operation, titanium mesh repairment. Abbreviations: CT, computed tomography; MRV, magnetic resonance venography. (Color version of figure is available online.)*

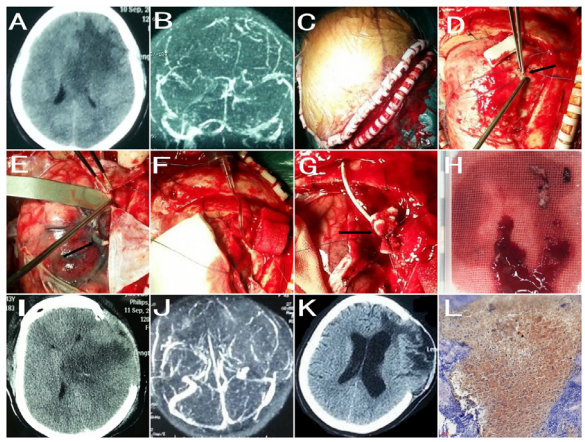

Figure 2. *Preoperative images, intraoperative findings, and postoperative imagines of the second patient. (A) preoperative CT; (B) preoperative MRV showed superior sagittal sinus and bilateral transverse sinus discontinuity; (C) scalp incision across the middle line; (D) bone flap and superior sagittal sinus incision (black arrow); (E) blood thrombus could be seen in the superficial cortical veins of the left frontal lobe (black arrow); (F) a tube was inserted into the sinus for thrombus aspiration; (G) a tube has been inserted into the sinus and fixed with the incision (black arrow); (H) intraoperative thrombus in the sagittal sinus; (I) head CT of 1 week after operation; (J) postoperative MRV; (K) head CT of 1 month after operation; (L) pathology of the thrombus (HE staining, *100). Abbreviations: CT, computed tomography; MRV, magnetic resonance venography. (Color version of figure is available online.)*

patients diagnosed with CVST as follows: (1) Cerebral hernia, aggravation progressively, and urgent surgical decompression is required; (2) Complicated with malignant cerebral infarction (and/not hemorrhage); (3) Endovascular interventions are not appropriate because of taboos; (4) The vital signs, including pulse, respiratory and blood pressure, are basically stable.

Methods

The authors performed a superior sagittal sinusotomy and sagittal sinus thrombolysis during decompressive craniectomy.

The size of the bone flap is determined by the severity of cerebral edema. The key point is to expose the anterior part of the superior sagittal sinus. The first patient underwent bilateral coronal incision for craniotomy. While the second patient received frontotemporal bone flap craniotomy. After cutting the dura matter for decompression, we found that the brain tissue was swollen. Then, a superior sagittal sinus incision was taken to detect sinus thrombosis. In order to facilitate bleeding during detecting the sagittal sinus, 2 silk sutures were sutured along the incision. The incision was 5 millimeters long approximately along the middle line of the front third of the superior sagittal sinus. We could see blood flow from the incision slowly. Insert the negative pressure suction device along the sinus through incision in a depth of about 7 cm; a small amount of blood clot was sucked out of the sinus. A silicone intubation was inserted in the sinus through the incision with a depth of 8 cm approximately. Thrombus was seen in the suction tube. At the depth of about 10 cm, while it is difficult to penetrate the tube, we used the gelatin sponge to cover the sinus incision and fixed the suture lines after cross-knotting. The silicone intubation was drawn out through the forehead and connected to external micro pump for injecting anticoagulant drugs, then cut the dura mater into star-shaped and discard bone flap for decompression. Absorbable artificial dura mater was used to repair bilateral dura mater, respectively. At last, we connected the catheter to the micro pump for pumping anticoagulant. During the operation of the second case, we found tight adhesions of left frontal lobe drainage veins with the dura mater, venous congestion, and intravenous gray thrombus (Fig 1D,E; Fig 2C-H).

Results

Both the 2 patients achieved incredibly good outcomes. After operation, both the patients received thrombolysis with Urokinase in different dosages or concentrations through the catheter placed in the sinus according to their postoperative conditions. The first patient' upper sagittal sinus catheter was given 500,000 U of Urokinase at a uniform rate within 3 hours. The second case was administered Urokinase for 5 days in the form of intravenous pump (with Urokinase 100,000 U added to 50 milliliters 0.9% sodium chloride injection at 4 mL/h. Pump for 3 days, and then reduce the volume to 2 mL/h for 2 days). Both of them recovered well. There was no incision-related bleeding occurred after surgery.

Three months after operation, the first case's modified Rankin Scale score of was 0, the Glasgow outcome scale score was 5 points. There was no obvious edema and infarction in the brain (Fig 1F-H). Her skull was repaired with titanium mesh (Fig 1I). The second case's modified Rankin Scale score of was 2, the Glasgow outcome scale score was 4. But she developed into hydrocephalus and need ventriculoperitoneal shunt (Fig 2I-K).

Discussion

Decompressive craniectomy is an important surgical technique for a difficult clinical situation of CVST.[1-3] During the last 2 decades, studies have shown that transtentorial herniation is the most frequent cause of early death in patients with CVST; data have amassed which suggest these patients are best treated with decompressive surgery.[5,10] In patients with impending transtentorial herniation, achievement of good recanalization through mechanical thrombectomy may not be the right answer to prevent death and those patients may benefit from emergent decompressive hemicraniotomy.[11] Decompressive surgery is the first choice in the treatment of 2 patients, if we can do the thrombectomy or thrombolysis during the decompressive surgery, it will be time-saving compared with endovascular thrombectomy or thrombolysis before or after the decompressive surgery. However, if we choose endovascular thrombectomy or thrombolysis rather than decompressive surgery for the first treatment, it is difficult to relieve intracranial hypertension and cerebral hernia immediately, or even make the situation worse; the 2 patients may die of cerebral hernia before decompressive surgery. Operative thrombectomy while doing decompressive craniectomy has true potential for improved outcomes. It may be an effective approach for surgical thrombectomy combined with thrombolysis through incising the superior sagittal sinus during decompression craniotomy on patients with malignant CVST complicated with cerebral hernia. There are many interesting topics during the operation and perioperative period, such as selection of incision location of the sagittal sinus, prevention of sinus's massive hemorrhage, detailed process of thrombectomy through the sagittal sinus and usage of thrombolytic drugs.

At present, there are few reports on the experience of cerebral sinusotomy. Does the sagittal sinus incision in the craniotomy cause uncontrollable hemorrhage? This is an important question in this surgery. According to the experience of lateral ventricle-superior sagittal sinus shunt for hydrocephalus, it was controllable and safe to perform sagittal sinus incision for thrombectomy; sinus bleeding could be avoided completely. In these 2 patients during

the operation, although the patient's distal sagittal sinus drainage was not smooth, but there was no uncontrollable hemorrhage intraoperation or postoperation.

However, it must be pointed out that anticoagulant therapy, intravenous thrombolysis, and endovascular intervention are still the main and preferred methods for the treatment of CVST without cerebral hernia in early stages.[6,8,9] Hybrid operation room may bring a better prognosis with the usage of balloon or embolus stent.

Conflicts of Interest

The author reports no conflicts of interest.

Ethical Standard

The study was conducted according to the ethical standards of the declaration of Helsinki.

Informed Consent

The patients have given her informed consent to this anonymous case report.

References

1. Zuurbier SM, Coutinho JM, Majoie CBLM, et al. Decompressive hemicraniotomy in severe cerebral venous thrombosis: a prospective case series. J Neurol 2012;259:1099-1105.
2. Aaron S, Alexander M, Moorthy RK, et al. Decompressive craniectomy in cerebral venous thrombosis: a single centre experience. J Neurol Neurosurg Psychiatry 2013;84:995-1000.
3. Zubkov AY, Mcbane RD, Brown RD, Rabinstein AA. Brain lesions in cerebral venous sinus thrombosis. Stroke 2009;40:1509-1511.
4. Coutinho JM, Zuurbier SM, Stam J. Declining mortality in cerebral venous thrombosis: a systematic review. Stroke 2014;45:1338-1341.
5. Saposnik G, Barinagarrementeria F, Brown RD, et al. Diagnosis and management of cerebral venous thrombosis: a statement for healthcare professionals from the American heart association/American stroke association. Stroke 2011;42:1158-1192.
6. Gulati D, Strbian D, Sundararajan S. Cerebral venous thrombosis: diagnosis and management. Stroke 2014;45:16-18.
7. Agrawal K, Burger K, Rothrock JF. Cerebral sinus thrombosis. Headache 2016;56:1380-1389.
8. Siddiqui FM, Dandapat S, Banerjee C, et al. Mechanical thrombectomy in cerebral venous thrombosis: systematic review of 185 cases. Stroke 2015;46:1263-1268.
9. Viegas L, Stolz E, Canhão P, Ferro JM. Systemic thrombolysis for cerebral venous and dural sinus thrombosis: a systematic review. Cerebrovasc Dis 2014;37:43-50.
10. Ferro JM, Crassard I, Coutinho JM, et al. Decompressive surgery in cerebrovenous thrombosis: a multicenter registry and a systematic review of individual patient data. Stroke 2011;42:2825-2831.
11. Stam J, Majoie CBLM, Delden OMV, et al. Endovascular thrombectomy and thrombolysis for severe cerebral sinus thrombosis: a prospective study. Stroke 2008;39:1487-1490.