Case Report

A simple and successful treatment for rupture and defect of the posterior third superior sagittal sinus caused by open depressed skull fracture: A case report

Geng-Huan Wang*, He-Ping Shen, Zheng-Min Chu, Jian-Guo Shen, Jian Shen

Department of Neurosurgery, The Second Affiliated Hospital of Jiaxing University, Jiaxing, 314000, Zhejiang Province, China

Article info

Article history:
Received 28 December 2020
Received in revised form 25 June 2021
Accepted 23 July 2021
Available online 3 August 2021

Keywords:
Depressed skull fracture
Superior sagittal sinus
Ligation
Prognoses

Abstract

It is extremely dangerous to treat the posterior third of the superior sagittal sinus (PTSSS) surgically, since it is usually not completely ligated. In this report, the authors described the case of a 27-year-old man with a ruptured and defective PTSSS caused by an open depressed skull fracture, which was treated by ligation of the PTSSS and the patient achieved a positive recovery. The patient’s occiput was hit by a height-limiting rod and was in a mild coma. A CT scan showed an open depressed skull fracture overlying the PTSSS and a diffuse brain swelling. He underwent emergency surgery. When the skull fragments were removed, a 4 cm segment of the superior sagittal sinus (SSS) and the adjacent dura mater were removed together with bone fragments. Haemorrhage occurred and blood pressure dropped. We completed the operation by ligating the severed ends of the fractured sagittal sinus. One month after the operation, apart from visual field defects, he recovered well. In our opinion, in primary hospitals, when patients with severely injured PTSSS cannot sustain a long-time and complicated operation, e.g., the bypass using venous graft, and face life-threatening conditions, ligation of the PTSSS is another option, which may unexpectedly achieve good results.

Introduction

Open depressed skull fractures (ODSFs) are very common in head injuries, and some patients require emergency surgery. When dealing with ODSF urgently, neurosurgeons are always alert to superior sagittal sinus (SSS) injury, as this may lead to catastrophic consequences. It is a controversial issue on how to deal with compound ODSF concerning SSS. An ODSF involving the anterior third of the SSS has a low operative mortality due to the ligation of the sinus. However, surgical treatment for the posterior third of the SSS (PTSSS) is extremely dangerous because it is usually not completely ligated. We described a case of 27-year-old man with ODSF involving the PTSSS, who was treated with ligation of the PTSSS and had a positive recovery.

Case report

A 27-year-old man was hit in the occipital region by a height-limiting bar while standing on a moving truck. He was immediately sent to our hospital. He was in a light coma with a Glasgow coma score of 10 on admission. On the back of his head, there was a 10 cm scalp laceration which was bleeding. A CT scan demonstrated an ODSF overlying the PTSSS in the occipital area and a diffuse brain swelling (Fig. 1).

During the preparation of the operation, the patient fell into a coma with a Glasgow coma score of 7. He underwent surgery in order to stop bleeding and to remove the depressed fragments which compressed PTSSS and the brain tissue. Before removal of the fragments, the SSS located at the two ends of depressed fragments was exposed. When the fragments were removed, massive bleeding occurred in the PTSSS and hypotension happened. We found that a 4 cm segment of SSS and adjacent dura under depressed fragments were removed along with bony fragments. Hemoglobin dropped to 65 g/L, and blood pressure dropped to 70/40 mmHg. Six units red cell suspension were given. We were unable to finish bypass surgery using venous graft due to the deterioration of the condition. Hemostasis was accomplished by ligating the broken ends of fractured sagittal sinus and sacrificing several cortical veins. The contusion and laceration of brain were found in bilateral parietal and occipital lobes. The dura mater defect was repaired with artificial dura mater.

* Corresponding author.
E-mail address: wanggenghuan@zjxu.edu.cn (G.-H. Wang).
Peer review under responsibility of Chinese Medical Association.

https://doi.org/10.1016/j.cjtee.2021.08.001
© 2021 Chinese Medical Association. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
The patient was given antibiotics for 48 h and sodium valproate for 1 week. The postoperative period was uneventful. The intracranial pressure remained below 25 mmHg for the following 7 days after surgery. One month after operation, apart from visual field defects, he recovered well. The patient could move his limbs freely and take care of himself. A magnetic resonance venography at 6 months after injury demonstrated absence of PTSSS and development of collateral circulation (Fig. 2). The bone defect was reconstructed by tanium frame with three-dimension shaping at 6 months after injury (Fig. 3). At his last follow-up examination, 60 months after surgery, he had no new neurological deficits and returned to work.

Discussion

Closed linear cranial fractures are conventionally regarded as nonoperative lesions unless they are accompanied by intracranial hematomas which require evacuation. In contrast, ODSFs are traditionally managed with aggressive treatments including debridement and cranioplasty due to their association with the entry of bacteria into the skull and cosmetic deformities. Late epilepsy also plays an important role in making a surgical decision. There have been some reports in the literature about intracranial hypertension caused by ODSF compression and obstruction of the SSS.

Surgical treatment of ODSF involving SSS is dangerous. Some scholars analyzed 39 cases of SSS injury and found that the total mortality rate was 41%, and all patients with PTSSS injury died. So adequate preoperative planning and preparation should be taken, if patients with ODSF overlying SSS needed surgery. Clinical manifestations and detailed imaging findings can help neurosurgeons to predict the degree of difficulty of the operation and to make proper arrangements for hemostasis. We prepared a large amount of blood
for the patient before surgery. Before the bony fragments compressing SSS were elevated, SSS at both ends of the bone fragments was exposed in order to control the profuse bleeding of SSS.

Dealing with ODSF involving the anterior SSS rarely produces serious complications due to the tolerability of sinus ligation. However, it is an arduous challenge for neurosurgeons to conduct surgical treatment for ODSF involving PTSSS. Reconstruction techniques including direct suture repair, patch suture, ligation of SSS, autogenous vein transplantation, and artificial sinus restoration have been applied. DiMeco et al. found that 10% of patients treated with SSS resection without venous reconstruction developed severe brain swelling. Sindou et al. reported that 72.7% of bypasses were unobstructed when using veins, but among patients using synthetic grafts, none of them were unobstructed despite the use of anticoagulants. Fortunately, most of the patients with thrombosed grafts remained asymptomatic. Reconstruction of SSS with bypass using venous grafts in brain injury is very rare because this operation is time-consuming and the bypass patency rate is low. So, the best way to deal with PTSSS seems to avoid intervening the SSS if at all possible.

We finally decided to perform surgery for this patient because he had many factors including brain swelling, continuous bleeding, dural penetration, depression greater than 1 cm, severe wound contamination. In this case, when removing the depressed fracture fragments, we found that the 4 cm SSS segment and the adjacent dura mater were lacking. Due to profuse bleeding, low blood pressure, severe brain swelling and deterioration of the condition, the operation could not be performed as planned. We had to ligate the broken ends of fractured SSS in order to stop the bleeding and accomplish the operation as soon as possible. Surprisingly, the patient’s prognosis was very good, leaving only partial visual field defects. However, this method is not suitable for ordinary sagittal sinus injuries that can be treated by conventional methods.

In conclusion, ODSF involving PTSSS rarely appears and is a very formidable challenge to deal with. Preoperative planning and preparation are crucial. This patient had a satisfactory recovery except for a partial visual field defect. This case illustrates that ligation of PTSSS does not necessarily cause severe neurological deficits or death. In primary hospitals, if patients with PTSSS rupture do not have the opportunity to complete the SSS reconstruction surgery, ligation of SSS can be tried.

**Funding**

This work was supported by Zhejiang Provincial Medical Science and Technology Program (2018YK802).

**Ethical statement**

This study was approved by the Ethics Committee of the Second Affiliated Hospital of Jiaxing University (20170719).

**Declaration of competing interest**

All authors declare that there is no conflict of interests.

**Author contributions**

Conceptualization: Geng-Huan Wang, He-Ping Shen. Data curation: Zheng-Min Chu, Jian-Guo Shen. Formal analysis: Geng-Huan Wang, He-Ping Shen. Funding acquisition: Geng-Huan Wang. Methodology: Jian Shen. Project administration: Geng-Huan Wang, He-Ping Shen. Writing-original draft: Geng-Huan Wang. Writing-review & editing: He-Ping Shen.

**References**

1. LeFeuvre D, Taylor A, Peter JC, et al. Compound depressed skull fractures involving a venous sinus. Surg Neurol. 2004;62:121–125. https://doi.org/10.1016/j.surneu.2003.10.048. discussion 125–126.

2. Meier U, Gartner F, Knopf W, et al. The traumatic dural sinus injury—a clinical study. Acta Neurochir. 1992;119:91–93. https://doi.org/10.1007/BF01541788.

3. DiMeco F, Li KW, Casali C, et al. Meningiomas invading the superior sagittal sinus: surgical experience in 108 cases. Neurosurgery. 2008;62:1124–1135. https://doi.org/10.1227/01.neu.0000313779.73940.c4.

4. Sindou MP, Alvernia JE. Results of attempted radical tumor removal and venous repair in 100 consecutive meningiomas involving the major dural sinuses. J Neurosurg. 2006;105:514–525. https://doi.org/10.3171/jns.2006.105.4.514.