Clinical Neurology and Neurosurgery 149 (2016) 87–93

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

Effective treatment via early cranioplasty for intractable contralateral subdural effusion after standard decompressive craniectomy in patients with severe traumatic brain injury

Yi Wan[a,1], Lei Shi[b,*,1], Zhimin Wang[a,*], Guan Sun[c,1], Tianhong Pan[b], Shuguang Zhang[b,1], Yanjun Zeng[d,*]

[a] Department of Neurosurgery, Suzhou Kowloon Hospital affiliated with Shanghai Jiao Tong University School of Medicine, Suzhou, 215021, PR China
[b] Department of Neurosurgery, The First People's Hospital of Kunshan affiliated with Jiangsu University, Suzhou, 215300, PR China
[c] Department of Neurosurgery, Fourth Affiliated Yancheng Hospital of Nantong University, Yancheng, 224000, PR China
[d] Biomechanics and Medical Information Institute, Beijing University of Technology, Beijing 100022, PR China

ARTICLE INFO

Article history:
Received 16 June 2016
Received in revised form 29 July 2016
Accepted 1 August 2016
Available online 2 August 2016

Keywords:
Intractable contralateral subdural effusion
Standard decompressive craniectomy
Cranioplasty
GOS score
Severe traumatic brain injury

ABSTRACT

Objective: This study aimed to introduce an effective treatment for intractable contralateral subdural effusion after standard decompressive craniectomy in patients with severe traumatic brain injury (TBI) and to analyze the underlying mechanism.
Methods: A retrospective analysis was performed in 13 patients with severe traumatic craniocerebral injury showing complicated intractable contralateral subdural effusion after standard decompressive craniectomy, in whom satisfactory results were not obtained from treatments, including compression bandaging, head-down bed rest (HDBR), continuing lumbar drainage, and Ommaya catheter drainage. Among these patients, 6 underwent temporal muscle sticking, while 7 underwent early cranioplasty. The postoperative changes in the subdural effusion were observed.
Results: In the 6 patients who underwent temporal muscle sticking and the 7 who underwent early cranioplasty, the subdural effusion completely resolved or was significantly reduced within one month, and no recurrence was observed in the 6-month follow-up period. However, secondary bilateral cranioplasty was still necessary in the postoperative 3–6 months for the patients who underwent temporal muscle sticking. In the early cranioplasty group, there were three total operations, and the average length of stay (ALOS) was 76 days. In the temporal muscle sticking group, there were four total operations, and the ALOS was 56.1 days. A retrospective analysis of surgical pain showed that 100% of the patients in the first group experienced unacceptable suffering, while 14.3% of the patients in the second group experienced pain.
Conclusion: Early cranioplasty is an effective, economical, and less painful treatment for intractable contralateral subdural effusion after standard decompressive craniectomy.

1. Introduction

Postoperative contralateral subdural effusion after standard decompressive craniectomy in patients with severe traumatic brain injury (TBI) is quite common, and special treatment is not needed in most cases [1]. However, in some patients, progressive contralateral subdural effusion may occur during the treatment process, resulting in midline shifting of brain tissue, which can seriously affect the recovery of brain function [2]. For these patients, after the application of one or more treatment measures, such as compression bandaging, head-down bed rest (HDBR), continuing lumbar drainage, or Ommaya catheter drainage, the effusion often seems to resolve. In cases in which no resolution occurs, effusion chamber-peritoneal shunting can be performed to prevent a further increase in effusion. However, poor drainage effects can be observed in some cases, with intractable effusion showing a high recurrence rate. Once the external drainage is removed, effusion occurs quickly (within a few days) and gradually increases in severity, result-

Abbreviations: HDBR, head-down bed rest; TBI, traumatic brain injury; HDBR, head-down bed rest; GCS, Glasgow Coma Scale; VP, ventriculo-peritoneal; GOS, Glasgow Outcome Scale; ALOS, average length of stay.

* Corresponding authors.
E-mail addresses: sl1012002322@126.com (L. Shi), wanyiwzm@126.com (Z. Wang), yjzeng@bjut.edu.cn (Y. Zeng).
[1] These authors contributed equally to this work.

http://dx.doi.org/10.1016/j.clineuro.2016.08.004
0303-8467/

Table 1
Clinical features of patients subjected to temporal muscle sticking or early cranioplasty for intractable subdural effusion.

Observation indicator	Temporal muscle sticking	Early cranioplasty	*P*
GCS	14.1	14.3	0.699
N			
Age, y	29	28.3	0.792
Gender			
Male	3	3	
Female	3	4	0.797
Temperature (°C)	36.3	36.5	0.385
Heart rate	69.5	69.6	0.988
Respiration rate	19	18.3	0.557
Blood pressure (systolic pressure)	120	116.7	0.370

ing in impaired consciousness in these patients. In such patients, intractable contralateral subdural effusion was found to easily convert into a chronic subdural hematoma during treatment, thereby preventing the placement of a subdural-peritoneal (SP) shunt. From March 2012 to September 2015, 13 patients with severe TBI showing intractable contralateral subdural effusion after standard decompressive craniectomy underwent either temporal muscle sticking or decompressive cranioplasty at our hospital. Our analysis showed that the therapeutic effects of both treatments for intractable subdural effusion were satisfactory, but the resultant trauma was relatively large with the former treatment, and secondary bilateral cranioplasty was needed.

2. Materials and methods

2.1. General information

From 2012 to 2015, 13 patients with intractable subdural effusion after standard decompressive craniectomy for severe TBI were admitted to our hospital. The patients included 7 males and 6 females, aged 21–35 years (mean age 32.1 ± 3.6 years). Three of the patients exhibited right frontotemporal parietooccipital subdural hematoma with cerebral contusion, subarachnoid hemorrhage, and left occipital fracture. Three patients showed simple subdural hematoma at the dorsal aspect of the right frontotemporal region, with brain contusion. Five patients presented left frontotemporal parietooccipital subdural hematoma with brain contusion and right occipital fracture. Two patients exhibited left frontotemporal parietooccipital subdural hematoma with severe left frontotemporal brain contusion, slightly right frontal lobe brain contusion, and right temporal occipital fracture. The patients' injuries were caused by traffic accidents (11 cases) or falling (2 cases). The time from the injury to the beginning of the operation was approximately 6 h. Postoperative contralateral subdural effusion occurred within one week after the surgery, with a the effusions tending to gradually increase in severity. Before the surgical procedure (i.e., temporal muscle sticking or cranioplasty), there were no significant differences between the two groups in routine monitoring indexes, including temperature, heart rate, respiration rate, blood pressure, and pre-operative GCS, (Table 1). This study was approved by the ethics committee of the hospital, and informed consent forms were signed by the family members of the patients.

2.2. Routine management procedures for subdural effusion

In the 13 patients with postoperative intractable contralateral subdural effusion after standard decompressive craniectomy for severe TBI, conventional compression bandaging on the bone window side was first carried out, together with HDBR. After ineffectiveness of this treatment was confirmed via cranial CT, external drainage with an Ommaya catheter or drill drainage was performed for the contralateral subdural effusion, with postoperative supporting drainage; compression bandaging on the bone window side was also provided. When a cranial CT scan revealed resolution of most of the contralateral subdural effusion, the drainage device was unplugged, while the compression bandaging on the bone window side was continued. However, within 3–5 days after the removal of the drainage device, a subdural effusion often quickly generated in the patients, who showed deepening unconsciousness or even coma. Although reexamination of cranial CT images showed retraction of the brain tissue due to compression bandaging, the contralateral subdural effusion clearly continued to worsen. Following immediate drainage, consciousness was significantly improved. After a period of continuing drainage, a cranial CT was performed again, and the drainage device was removed if the contralateral subdural effusion had mostly disappeared. The effusion was characterized by recurrence, and the patients experienced the above conditions again after remaining stable for 3–5 days. Thus, after performing the above treatment strategy for 1–2 months, the patient was informed that they were diagnosed with intractable subdural effusion. The measures of conventional compression bandaging, HDBR, and Ommaya catheter drainage were not effective. Temporal muscle sticking or early cranioplasty was needed. Furthermore, during the drainage of the subdural effusion, the clear drainage fluid transformed into a light soy sauce-colored liquid with a granular precipitate, subsequently taking on a pale yellow coloration after continuing drainage, and then returning to a clear liquid in some patients, suggesting that the intractable subdural effusion could be easily converted into a chronic subdural hematoma during effusion treatment.

2.3. Surgery and treatment methods

The temporal muscle sticking operation was undertaken as follows. A craniotomy was performed under general anesthesia, with a semi-curved incision slightly smaller than that for a standard large trauma. Briefly, the anterior came within 2 cm of the frontal pole, and the posterior line was approximately 3 cm posterior to the external acoustic meatus. The superior line was 3 cm from the lateral edge of the central line, and the inferior line extended 1 cm anterior to the antilobium. It was not necessary for the bone window to reach the middle cranial fossa to mitigate the pressure on the center of the brain. The superficial temporal artery was retained during the surgery and was separated together with part of the temporal fascia and muscle flap, with sufficient hemostasis. A hole was drilled in front of the pterion, and part of the skull bone was removed, leaving a bone window with an area of approximately 8×10 cm to suspend the dura. After the dura was radially cut, the subdural effusion gushed out, showing a clear cerebral pulse. Following rinsing of the effusion with sterile saline, the transparent white or light yellow pseudomembrane was removed. Next, the arachnoid in the sylvian cistern was carefully torn, and the space along the vessel was maximized, with hemostasis and repeated washing until clear. After checking again to ensure that no significant bleeding occurred at the muscle flap, the muscle flap was placed under the dura and attached to the brain surface. The drainage was then set up, and the muscle flap fascia was tightly sutured with the dura, followed by the stratification suture. The drainage was usually extubated within 3 days after the surgery.

The cranioplasty proceeded as follows. The contralateral effusion was preoperatively drained so that the subdural effusion was significantly reduced, or the contralateral subdural effusion was intraoperatively rinsed and drained to ease brain tissue swelling out of the bone window edge on the cranioplasty side. After the encephalocele was alleviated, the cranioplasty was performed. All of the patients were under general anesthesia during the surgery. The scalp was cut in layers along the original incision or an incision,