

Sinking skin flap syndrome and paradoxical herniation secondary to lumbar drainage



Jinchuan Zhao, Guichen Li, Yang Zhang, Xiaobo Zhu, Kun Hou*

Department of Neurosurgery, First Hospital of Jilin University, Changchun, China

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ABSTRACT

Objective: Decompressive craniectomy (DC) has been regaining popularity in the field of neurosurgery because it can alleviate intracranial hypertension and brain swelling. Lumbar drainage (LD) is effective in managing numerous neurosurgical circumstances such as aneurysmal subarachnoid hemorrhage, refractory intracranial hypertension, cerebrospinal fluid (CSF) leakage and intraoperative brain relaxation. Sinking skin flap syndrome (SSFS) or paradoxical herniation (PH) is a rare complication and sporadically occurs in patients after DC. Hereby, we report for the first time that DC patients with LD can progress to SSFS or PH. We also evaluated the risk factors for the incidence of SSFS in DC patients with LD.

Methods: We retrospectively assessed 37 patients who underwent DC and LD for cerebrovascular diseases from the First Hospital of Jilin University between January, 2007 and December, 2012.

Results: Nine (4 male and 5 female) of 37 patients experienced SSFS or PH following LD. At the last follow-up (mean 9 months, range 6–12 months), eight patients recovered completely due to timely conservative management and one patient died from PH. The mortality rate was 11% (1/9) from the complications of PH or SSFS. Further statistical analysis revealed that mean daily CSF volume was a risk factor for the incidence of SSFS in DC patients with LD.

Conclusions: SSFS or PH can be identified in DC patients following LD. Patients that undergo DC and LD should be monitored more intensively. Most patients can completely recover with timely conservative management, bed rest, Trendelenburg position, sufficient intravenous fluid, and temporary clipping of the catheter.

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1. Introduction

Sinking skin flap syndrome (SSFS) is a rare complication following large craniectomy and usually manifests as mental state decline, severe headache, seizures or focal deficits after a relatively stable and improved stage. It occurs from several weeks to months after decompressive craniectomy (DC). Without early identification and management, SSFS may progress to “paradoxical herniation” (PH) as a consequence of the atmospheric pressure exceeding intracranial pressure. This can eventually lead to coma and sudden death [1–3]. Since the first description of SSFS by Grant and Norcross in 1939 [4], more clinicians have realized the complications associated with DC [1,5–7].

Lumbar drainage (LD), which was first used by Vourch in 1963 [8], has gained wide popularity in many neurological and neurosurgical centers all over the world [9,10]. It has been successfully used in numerous neurosurgical circumstances such as aneurysmal subarachnoid hemorrhage, refractory intracranial hypertension, cerebrospinal fluid (CSF) leakage, and intraoperative brain relaxation [11–14]. Moreover, in our center, we have routinely applied LD in patients with subarachnoid hemorrhage since 2007. To our knowledge, the relationship between SSFS or PH and LD in DC patients has rarely been studied. Hereby, we retrospectively report nine DC patients who suffered from SSFS or PH following LD.

2. Material and methods

2.1. Patients

We retrospectively reviewed the records of patients who underwent DC and LD for cerebrovascular diseases at the First Hospital of Jilin University between January, 2007 and December, 2012. The

* Corresponding author at: Department of Neurosurgery, First Hospital of Jilin University, 71 Xinmin Avenue, Changchun 130021, China. Tel.: +86 18704479380; fax: +86 043184808174.

E-mail address: hkyayz@yeah.net (K. Hou).

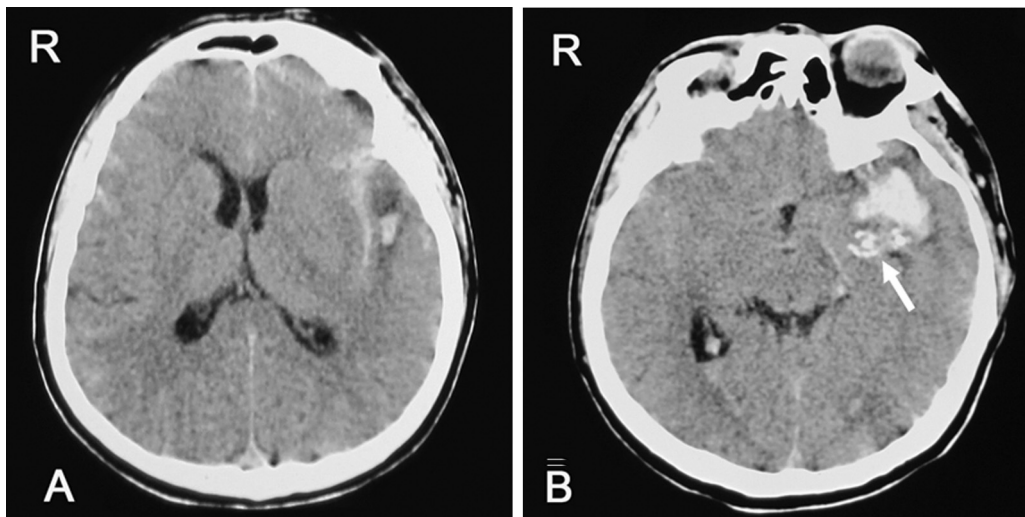


Fig. 1. Preoperative CT showing subarachnoid hemorrhage (A), calcification (arrow) and parenchymal hemorrhage (B) in the left hemisphere. This patient had an arteriovenous malformation (A–V) in the left temporal lobe on CT angiography.

study was approved by the Ethics Committee at the First Hospital of Jilin University.

According to the established surgical criteria, DC was performed in the setting of uncontrolled intracranial pressure or postoperative cerebral edema, as demonstrated by brain imaging and intraoperative findings. Moreover, in patients with primary or secondary subarachnoid hemorrhage, LD was used to prevent complications induced by blood cells and their degenerative products under the subarachnoid cavity. Since it is hard to clinically identify the subtle mental status changes in patients with poor consciousness, patients with a Glasgow Coma Scale less than 12 were excluded in this study.

2.2. LD

A lumbar catheter was inserted via a 14-gauge Touhy needle in the lateral decubitus position when the aforementioned criteria were met. The L3–4 intervertebral space was most frequently selected for the lumbar puncture site. We performed a continuous drainage method. The targeted drainage volume was approximately 200–300 ml/24 h according to the general state of the patient.

2.3. SSFS diagnosis and management

The diagnosis of SSFS or PH was based on clinical manifestations and neuroimaging. An emergent computed tomography (CT) evaluation was performed to rule out the possibility of over-drainage or other hemorrhagic events if new symptoms emerged such as headache, nausea, cranial nerve palsies, focal deficits or mental alterations. Specifically, the diagnosis of SSFS or PH was confirmed if CT images revealed a tight ventricular system and basal cisterns, midline shift opposite of the skull defect, or depressed skin flaps (Figs. 1–4). Once the diagnosis of SSFS or PH was confirmed, the drainage catheter was temporarily clipped and patients were placed in a supine or Trendelenburg position with sufficient intravenous fluids.

2.4. Statistical analysis

Four variables, including age, sex, side of the responsible lesion and mean daily CSF volume, were obtained from the studied patients. Continuous variables such as age and mean daily CSF

volume were expressed as mean \pm SD and assessed with a student's *t*-test. Categorical variables were assessed by chi-squared or Fisher exact tests. Statistical analysis was performed using SPSS Version 17.0. Specifically, $p < 0.05$ was considered statistically significant.

3. Results

We identified 37 patients with DC and LD according to the established inclusion criteria. Nine (4 male and 5 female; mean age, 58.3 years [range 35–70 years]) of the 37 patients suffered SSFS or PH. The clinical characteristics, including demographic data, clinical presentations, primary lesions and managements, are shown in Table 1. Most patients complained of a progressively worsening headache, disturbance of consciousness or muscle strength impairment. Some patients had vomiting, sweating and dizziness.

Notably, all but one patient recovered completely due to timely conservative management, including temporary catheter clipping, putting the patient in a Trendelenburg position and providing sufficient intravenous fluids. There was a mortality rate of 11% (1/9)

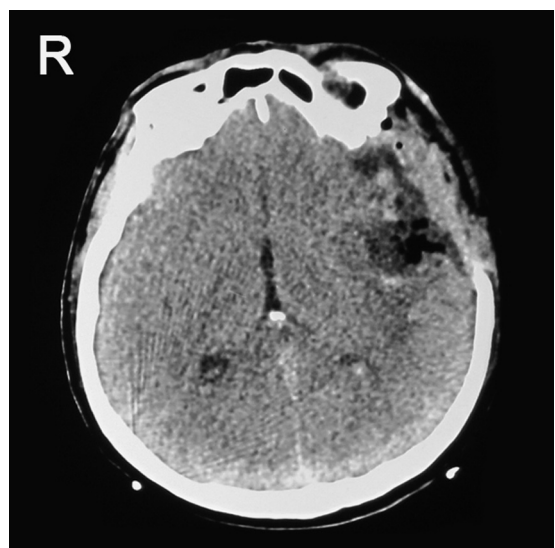


Fig. 2. Postoperative CT showing that the ventricles and cisterns were normal after A–V resection and decompressive craniectomy.

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