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CASE REPORT

Removal of a minimal amount of subdural hematoma is effective and sufficient for term neonates with severe symptomatic spontaneous parenchymal hemorrhage

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Abstract

Introduction Spontaneous parenchymal hemorrhage of term neonates is usually asymptomatic and does not require surgical intervention. However, there is no consensus on the management of cases with severe life-threatening symptoms, including repeated apnea, respiratory failure with severe cyanosis, severe bradycardia, or uncontrolled seizures.

Cases Our medical records of term neonates with intracranial hemorrhage who underwent surgical intervention were retrospectively reviewed. There were two cases with spontaneous parenchymal hemorrhage. Both cases were delivered vaginally without any use of forceps or vacuum devices. Neither of them showed asphyxia, hypoxic-ischemic encephalopathy, hematological abnormalities, congenital vascular anomalies, infection, or birth trauma. Common symptoms included apnea, cyanosis, bradycardia, and decreased consciousness. The original location of bleeding was the parenchyma of the right temporal lobe. The hemorrhage extended to subdural spaces in both cases. Subdural hematoma (SDH) removal was performed without manipulating the parenchymal hematoma. Only a small amount of SDH (approximately 5 ml) was drained spontaneously with irrigation, which was sufficient to decrease the elevated intracranial pressure. The patients' respiratory conditions improved dramatically after the surgery.

Conclusion We propose that removing only a small amount of SDH would be effective and sufficient to relieve severe symptoms of increased intracranial pressure in term neonates with massive spontaneous parenchymal hemorrhage.

Keywords Spontaneous parenchymal hemorrhage · Superficial parenchymal and leptomeningeal hemorrhage · Term · Neonate

Introduction

Parenchymal hemorrhage of term neonates can occur due to various etiologies including asphyxia, hypoxic-ischemic encephalopathy, hematological abnormalities, congenital vascular anomalies, infection, or birth trauma [1, 3, 5, 6, 8, 9, 12]. The most common symptoms are seizure, apnea, and bradycardia [1, 2, 5, 6, 8, 12]. Surgical removal of parenchymal hemorrhage is in most cases not indicated [4–7, 9]. The presence of asphyxia or hypoxic-ischemic encephalopathy is reported to be an important risk factor for mortality and morbidity [2, 7, 8, 10]. On the other hand, it is well known that the clinical outcomes of idiopathic or spontaneous parenchymal hemorrhage with conservative observation are usually good, partly due to neonatal brain plasticity [5, 9, 11, 12]. Aggressive surgical removal is rather avoided because the neonatal brain is very fragile, and even a small amount of intraoperative blood loss could be fatal in neonates.

However, there is no consensus on the management of spontaneous parenchymal hemorrhage in term neonates with severe life-threatening symptoms, including repeated apnea, respiratory failure with severe cyanosis, severe bradycardia, or uncontrolled seizures. We herein reported two cases of severe symptomatic parenchymal hemorrhage that required surgical intervention. The role of surgery in neonatal symptomatic spontaneous parenchymal hemorrhage is discussed.

Case reports

Case 1

This boy was born at a gestational age of 38 weeks and 4 days by natural vaginal delivery (weight, 3240 g; Apgar

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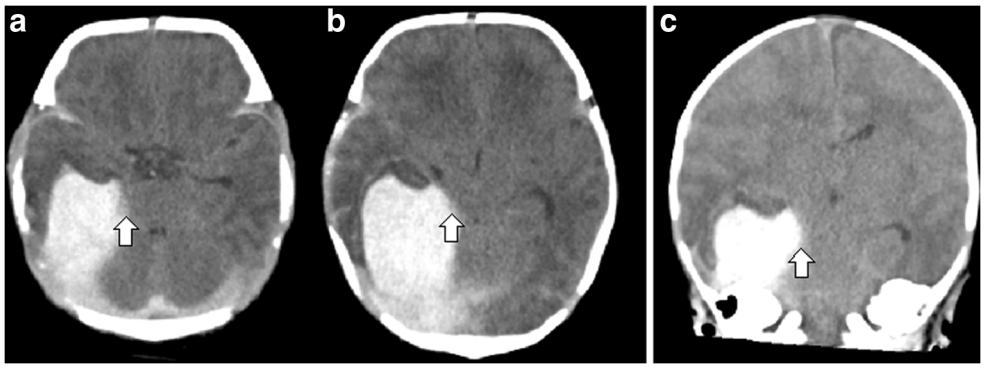

Fig. 1 Preoperative CT images of Case 1 on postnatal day 1. **a**, **b** Axial and **c** coronal images. Parenchymal hemorrhage in the right medial temporal lobe extends to the subdural spaces of the middle and posterior fossae. The ambient cistern is not seen due to the hematoma and cortical swelling (indicated by the *arrows*)

score, 8 at 1 min and 10 at 5 min). He had no symptoms until postnatal day 1 when he started to show cyanosis and bradycardia (less than 90 beats per minute). The anterior fontanelle was very tense. Head CT showed parenchymal hemorrhage in the medial temporal lobe and SDH (Fig. 1). The ambient cistern was compressed with hematoma. Emergent SDH removal was performed. During the operation, a small dural incision was made between the parietal and temporal bones. A small amount of SDH (i.e., approximately 5 ml) was removed spontaneously by irrigation. Further removal of the SDH was avoided because the anterior fontanelle became soft. The postoperative MRI (Fig. 2) showed the majority of the subdural and parenchymal hematoma remained. MRI also showed the presence of subpial or subarachnoid hemorrhage along the medial surface of the right temporal lobe. The patient was discharged on postnatal day 31 without any neurological deficits. He had been followed up for more than 12 months with normal developmental milestones.

Case 2

This girl was born at a gestational age of 39 weeks and 0 days by natural delivery (weight, 2962 g; Apgar score, 9 at 1 min and 10 at 5 min). She started to show prolonged apnea and severe cyanosis on postnatal day 1. Her anterior fontanelle was bulging. Head CT showed massive hemorrhage in the parenchyma of the right lateral temporal lobe and surrounding subdural space (Fig. 3). SDH removal was performed on postnatal day 2. During the operation, a burr hole was made in the right parietal bone, and a minimal amount of SDH (i.e., approximately 5 ml) was drained by irrigation through the burr hole. MRI on postnatal day 5 showed that the majority of the parenchymal and subpial hemorrhage remained (Fig. 4). However, her respiratory condition improved dramatically after the operation.

Discussion

Spontaneous parenchymal hemorrhage in term neonates

The original locations of bleeding in Cases 1 and 2 were thought to be the parenchyma of the left medial and lateral temporal lobes, respectively. MRI of Case 1 showed the lining of the blood component along the medial surface of the right temporal lobe, indicating subpial or subarachnoid hemorrhage (Fig. 2). T2-weighted imaging of Case 2 showed that the lesion contained an area of

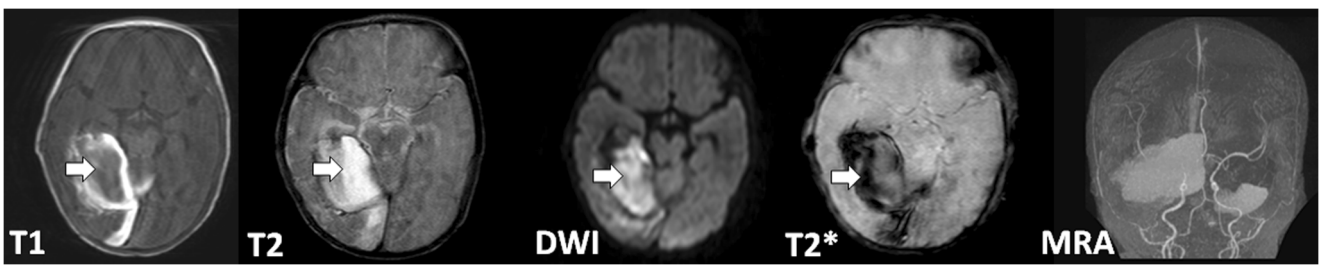

Fig. 2 Magnetic resonance (MR) images of Case 1 one week after surgery. Axial T1-weighted image (T1), T2-weighted image (T2), diffusion-weighted image (DWI), T2* image (T2*), and coronal MR angiography (MRA) are shown. The parenchymal and subpial/subarachnoid hemorrhage of the right medial temporal lobe is indicated by the *arrows*. Minimal but sufficient removal of hematoma in the ambient cistern was achieved, though the majority of the subdural and parenchymal hematoma remained. MRA does not show any vascular anomalies

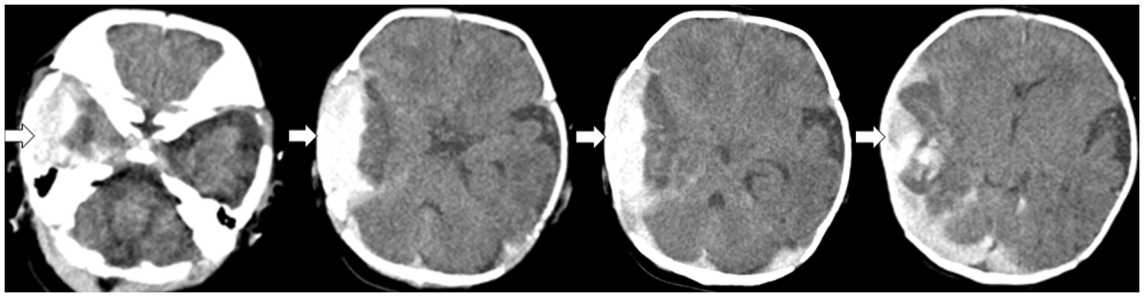

Fig. 3 Preoperative CT images of Case 2 on postnatal day 2. The original location of hemorrhage is the parenchyma of the right lateral temporal lobe (indicated by the *arrows*)

cortical swelling adjacent to the hemorrhagic site, and diffusion-weighted imaging (DWI) also showed a restricted diffusion coefficient in the parenchyma in close proximity to the right pterion and coronal suture (Fig. 4). These findings indicate spontaneous superficial parenchymal and leptomeningeal hemorrhage (SPLH) as the etiology of bleeding.

SPLH was first proposed by Huang and Robertson in 2004 to describe a rare subset of full-term intracranial hemorrhage associated with spontaneous cortical and leptomeningeal (i.e., subpial or subarachnoid) hemorrhage [9]. SPLH usually occurs in patients with normal birth weight, no prenatal complications, high Apgar scores, and no medical record of complicated deliveries (i.e., birth trauma). The pathophysiology of SPLH is still unclear, but it has been proposed to be venous or capillary-venous injury of the superficial parenchyma with local trauma. Huang and Robertson proposed that SPLH frequently occurred in the anterior-inferior-lateral temporal lobe adjacent to the pterion [9], as in the present Case 2. The majority of neonates with SPLH will make a complete recovery with conservative treatment. They claim that surgery is usually contraindicated in neonatal SPLH [9].

Surgical removal of SDH associated with SPLH

Management of SPLH associated with severe life-threatening symptoms, as in the present cases, is still controversial. It has been proposed that aggressively removing a parenchymal hematoma of a few-day-old neonate could cause surgery-related brain injury [4]. Achieving adequate hemostasis in the white matter of such neonates is very difficult even for skilled neurosurgeons [4, 12]. It has also been said that the brain at this age is 90% water and can easily be aspirated during surgery [4]. Thus, neurosurgeons should carefully compare any benefit of surgery to the risk of further damaging the brain.

In the present cases, the plan was to remove only a small amount of SDH without manipulating the parenchymal hemorrhage. During the operation, draining a minimal amount of SDH spontaneously through the dural incision with irrigation was sufficient to accomplish anterior fontanelle decompression. Removing only about 5 ml of SDH was sufficient in both cases. In doing so, longer surgical time and increased amount of hemorrhage caused by aggressive hematoma removal were avoided. Postoperative imaging showed that the majority of SDH and all of the parenchymal hematoma remained, but the respiratory conditions of both patients dramatically improved after the surgery.

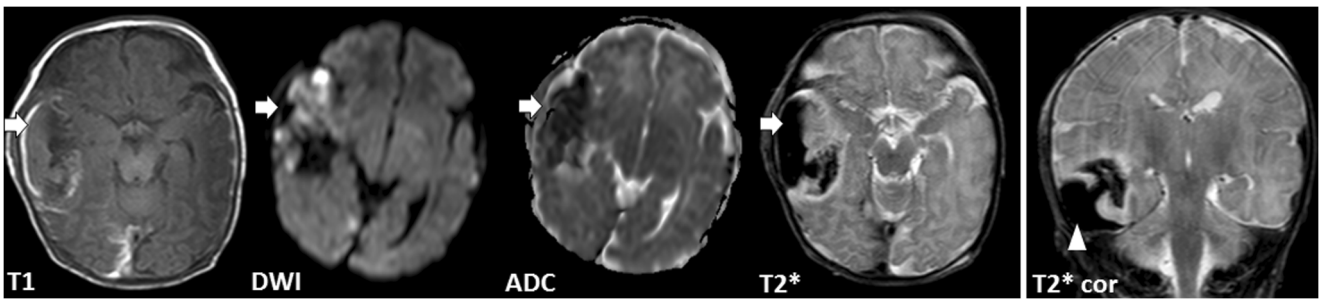

Fig. 4 Postoperative MRI of Case 2 on postnatal day 5. Axial T1-weighted image (T1), diffusion-weighted image (DWI), ADC map (ADC), T2* image (T2*), and coronal T2* image (T2* cor) are shown. The parenchymal hemorrhage (indicated by the *arrows*) is located in the anterior-inferior-lateral temporal lobe adjacent to the pterion, with a restricted diffusion coefficient on DWI and the ADC map. The parenchymal hemorrhage extends to the subdural space of the middle fossa (indicated by the *arrowhead* in the coronal T2* image)

Conclusion

Most term neonates with spontaneous parenchymal hemorrhage do not require surgery. However, in cases with severe symptoms of increased intracranial pressure, surgical removal of a minimal amount of SDH should be considered.

Compliance with ethical standards

All procedures performed in this study were in accordance with the ethical standards of the institutional review board.

Conflict of interest The authors declare that there is no conflict of interest.

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