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TECHNICAL NOTE

Use of flexible endoscopic aspiration for an intraventricular small floating clot with hemorrhage: a technical note

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Abstract

Background Although flexible endoscopy is effective for intraventricular lesions, it is less frequently used for hemorrhagic cases. In some hemorrhagic strokes, blood clots may plunge into the cerebral aqueduct and cause acute obstructive hydrocephalus. A flexible endoscope can aspirate clots and prevent acute hydrocephalus.

Methods Here, we report four cases of hemorrhage: one of intracerebral hemorrhage and three of subarachnoid hemorrhages.

Results In all cases, acute hydrocephalus was not apparent upon admission. Sudden comatose occurred; computed tomography revealed acute obstructive hydrocephalus with a strangulated clot in the cerebral aqueduct. We performed aspiration of the strangulated clot using a flexible endoscope. Consciousness improved in all cases, and acute hydrocephalus was prevented in all cases.

Conclusion The use of simple flexible endoscopic aspiration for clots might be a beneficial and less-invasive procedure for acute obstructive hydrocephalus caused by a small clot with hemorrhagic stroke.

Keywords Flexible endoscopy, Cerebral aqueduct, Acute hydrocephalus, Clot, Aspiration

Introduction

Neuroendoscopic procedures have been developed over several decades. In particular, flexible neuroendoscopy is employed in patients with intraventricular lesions in hemorrhagic disease as well as in tumors [2, 7, 8, 14, 21, 22]. Intraventricular hemorrhage with stroke disrupts the cerebrospinal fluid (CSF) [1] circulation and results in to acute obstructive hydrocephalus. Neuroendoscopic aspiration provides a minimally invasive and safe means to remove hematoma and results in static CSF circulation [1, 12]. Small floating clots may infrequently plunge into the cerebral aqueduct and result in obstructive hydrocephalus [6]. CSF drainage is usually proposed in rare, urgent clinical situations [9, 20], and few cases involving neuroendoscopic aspiration for stuck floating clots have been reported [5, 13].

Here, we treated four cases by performing flexible endoscopic aspiration for stuck floating clots and described the pitfalls of this procedure.

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Methods

Case series

Small floating clots were aspirated using a flexible neuroendoscope in four cases. Table 1 shows the characteristics of the four patients: three patients had subarachnoid hemorrhage and one patient had intracranial hemorrhage. All patients presented a sudden decreased level of consciousness a day after initial treatment for the primary disease or on admission. Computed tomography (CT) revealed slight enlargement of the lateral ventricle, with plunging of the clot into the cerebral aqueduct (Figs. 1 and 2).

Table 1 Characteristics of the cases

Case	Sex	Age	Primary disease	Symptom
1	Female	77	Subarachnoid hemorrhage	Sudden deterioration of consciousness
2	Female	68	Subarachnoid hemorrhage	Sudden deterioration of consciousness
3	Female	84	Intra cerebral hematoma (cerebellum)	Deterioration of consciousness
4	Male	64	Subarachnoid hemorrhage	Deterioration of consciousness

Operative technique

Patients were laid in a supine position on the treatment table under general anesthesia. The cranium was fixed in a median position on a horseshoe headrest. Then, a 3-cm longitudinal skin incision was made and a burr hole was drilled on the right side at the Kocher's point located 3 cm lateral and 10 cm posterior from the nasion. A peel-off sheath (Neurosheath, diameter 17.5 French, Medikit, Tokyo, Japan) was inserted 3.5–4.0 cm to the right anterior horn of the right lateral ventricle. A flexible neuroendoscope (VEF-V, Olympus, Tokyo, Japan) with an operative working channel reached the right lateral ventricle through the sheath; we identified the anatomical landmarks, such as the foramen of Monro at the center, choroid plexus on the left side, thalamostriate vein downward from the foramen of Monro, and anterior septal vein upward from the foramen of Monro. The endoscope circumspectly passed through the foramen of Monro and progressed into the third ventricle. We turned the tip of the neuroendoscope toward the posterior part of the third ventricle and aspirated the small floating clot plugged in the cerebral aqueduct via aspiration with a syringe through the working channel of the endoscope. We confirmed a clear entrance of narrow cerebral aqueduct after aspiration, followed by careful withdrawal of the endoscope. An external ventricular drainage was inserted into the lateral ventricle for the management of elevated intracranial pressure in case of acute re-occlusion. CT on the following day ascertained the improvement of acute hydrocephalus, and the drainage catheter was either removed or effectively used to monitor intracranial pressure after subarachnoid hemorrhage. The drainage catheter after subarachnoid hemorrhage was removed after approximately 10 days in case of a regular, uneventful postoperative course.

Results

All procedures were performed within 2 h. In all cases, only 5–10 ml of aspiration, including CSF, was needed to achieve clot removal and clearance of the plug of the cerebral aqueduct without injuring the foramen of Monro, the third ventricle, and the cerebral aqueduct itself. Quick emergence from anesthesia in all cases was achieved, with improved consciousness. CT images on the following day revealed ventricular size improvement and no other floating clots in all cases without CSF drainage. None of the patients presented with recurrence of acute hydrocephalus. Image follow-up in 1 month was

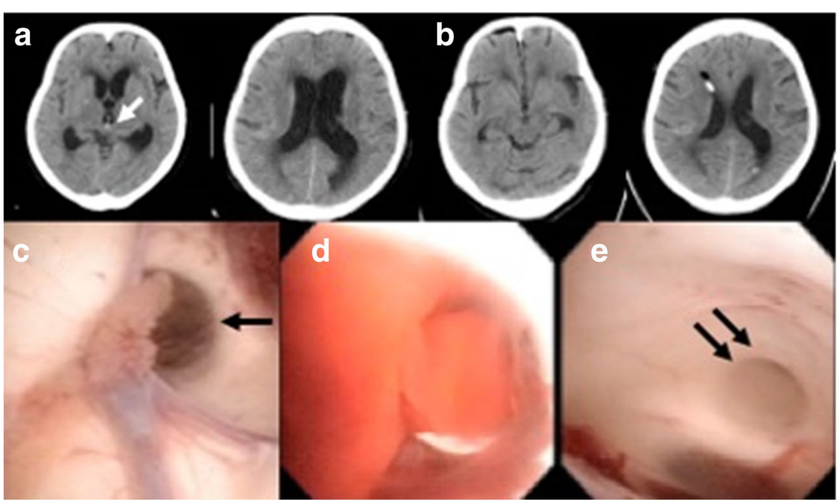

Fig. 1 A female patient, 77 years of age, was admitted to our hospital with subarachnoid hemorrhage. Endovascular embolization was performed to treat a ruptured dissecting aneurysm of the left posterior inferior cerebral artery. The patient became comatose state on the first postoperative day. **a** CT images on acute deterioration showing a clot plugging the cerebral aqueduct (single white arrow) and moderate enlargement of the cerebral ventricle. **b** CT images after the procedure showing clot removal and improved cerebral ventricle size. **c** As the endoscope approached from the right anterior horn, the size of the foramen of Monro (single black arrow) was not enlarged. **d** A red clot plugged into the cerebral aqueduct. **e** The clot was removed and a narrow cerebral aqueduct was observed (double black arrow)

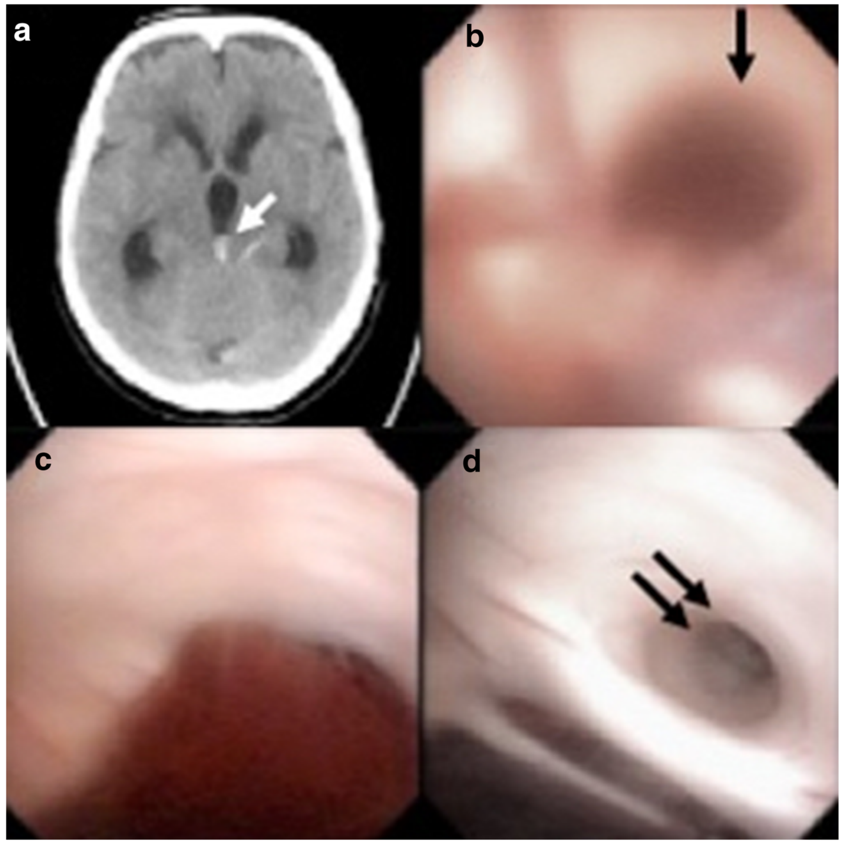

Fig. 2 A female patient, 68 years of age, was admitted to our hospital with subarachnoid hemorrhage. Endovascular coil embolization was performed to treat ruptured saccular aneurysm on the bifurcation on the basilar artery–left anterior inferior cerebral artery. Consciousness was depressed on the first postoperative day. **a** Pre-operative CT image showing a clot plugging the cerebral aqueduct (single white arrow) with moderate enlargement of the cerebral ventricle. **b** As the endoscope approached from the right anterior horn, the size of the foramen of Monro (single black arrow) was not enlarged. **c** A dark red clot existed just at the entry of the cerebral aqueduct. **d** The clot was aspirated and a clear, normal cerebral aqueduct was observed (double black arrow)

available for all cases; shunt procedure was required in one patient with subarachnoid hemorrhage.

Discussion

The primary hemorrhagic diseases observed with acute obstructive hydrocephalus caused by small clots include hypertensive intracranial hematoma, subarachnoid hemorrhage, arteriovenous malformation, intraoperative and postoperative bleeding, and trauma [5, 6, 9, 10, 13, 17, 18, 23]. The occurrence frequency of this type of obstructive hydrocephalus is low, and only few cases have been reported. The cerebral aqueduct is an anatomically narrow and sensitive triangular pathway of the CSF, which requires gentle and careful operative procedures [15, 16]; an extremely tiny scattered floating clot may plug the cerebral aqueduct. The primary symptom of this type of obstructive hydrocephalus is exponential consciousness disorder. Because the mechanism of this type of hydrocephalus is similar to that of acute closure of the orifice after endoscopic third ventriculostomy (ETV), the intracranial pressure is momentarily increased and the symptoms are drastically severe compared with the enlargement of the ventricles. Therefore, the therapeutic strategy for this type of obstructive hydrocephalus should be instantaneously decided. Although the clot spontaneously flows off to the fourth ventricle in some cases, first-line therapy is external ventricular drainage (EVD) [6, 9, 18]. EVD is certainly effective; nevertheless, it has some problems because EVD as an approach for clot removal increases the risk of infection and is a time-consuming procedure [3, 11, 20]. Endoscopic, particularly flexible endoscopic, aspiration is a common technique for intraventricular massive hemorrhages regardless of the type of hydrocephalus [2, 7, 22]. The foramen of Monro and the anterior part of the third ventricle are easily and safely reached by a rigid endoscope; however, it is difficult to safely achieve an optimal angle in the posterior part of the third ventricle and the cerebral aqueduct in normal anatomical restriction [4, 19, 22]. We treated the lesions around the cerebral aqueduct with a flexible endoscope. We sometimes clinically encounter a case of hydrocephalus caused by obstructive aqueduct by a small amount of clot or adherent membrane after intraventricular hemorrhage. Frequently, patients with partial obstruction develop mild hydrocephalus, wherein the ventricles are found to be nearly normal in size. The most important detail in the endoscopic aspiration technique is to carefully aspirate the clot without injuring the surrounding normal ependymal tissues. Only clot aspiration without additional ETV and observation of the fourth ventricle passing the cerebral aqueduct reduced complications and shortened the operative period. In our series, no invasion of the foramen of Monro, base of the third ventricle, and cerebral aqueduct as well as no re-occlusion of the cerebral aqueduct by another clot were revealed. All procedures took less than 40 min. Flexible endoscopic aspiration of an intraventricular, small, floating clot is an appropriate technique and is a minimally invasive and brief procedure.

Chronic hydrocephalus after intraventricular hemorrhage is a major subject of research. The neuroendoscopic removal of intraventricular massive casting hematoma may avoid chronic hydrocephalus [2, 7, 22]. This obstructive hydrocephalus caused by a small clot has a different mechanism of causing hydrocephalus from stuck floating hematoma; chronic hydrocephalus hardly occurs after the dissolution of the small clot [9]. No repetitive occlusion by the small clot was reported. In this study, re-occlusion with a small clot was evaded, and one patient with subarachnoid hemorrhage developed chronic hydrocephalus. The procedure described in the present study may prevent acute hydrocephalus with stuck floating hematoma, while chronic hydrocephalus depends on the primary disease. This study describes the treatment of acute obstructive hydrocephalus due to a stuck floating clot in the cerebral aqueduct with satisfactory results with a short-term follow-up duration; meanwhile, a long-term follow-up is mandatory to exclude chronic hydrocephalus after subarachnoid hemorrhage.

Conclusion

Although acute obstructive hydrocephalus caused by a small clot with hemorrhagic stroke is relatively rare, prompt judgment of the diagnosis and procedure is essential. Simple flexible endoscopic aspiration for clots might be a beneficial and less-invasive procedure.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical approval This study was approved by the Institutional Review Board of Saitama Cardiovascular and Respiratory Center, Saitama, Japan.

Informed consent Informed consent was obtained from the patient.

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