CASE REPORT

Postoperative epidural haematomas associated with hydrocephalus caused by intraoperative overdrainage of cerebrospinal fluid: two case reports with a literature review of 19 cases

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SUMMARY

We report two cases with postoperative epidural haematomas (EDHs) associated with hydrocephalus and discuss the cause of haematoma development on the basis of a literature review. A 13-year-old boy presented with obstructive hydrocephalus caused by a sellar mass lesion. Multifocal EDHs occurred after partial resection of the lesion via a transcallosal approach following ventricular drainage. In the second case, a 26-year-old man who had a history of ventriculoperitoneal shunting for congenital hydrocephalus presented with hydrocephalus caused by ventricular catheter obstruction. An EDH occurred after replacement of the ventricular catheter with a new burr hole opening. On the basis of a review of 19 cases including our two cases, the authors concluded that postoperative EDH development associated with hydrocephalus was mostly caused by intraoperative overdrainage of cerebrospinal fluid, resulting in rapid shrinkage of the brain with dilation of the epidural space, a situation that may have caused dural venous bleeding.

BACKGROUND

The common complications of neurosurgical operations are haemorrhage, infarction, infection, cerebral damage, cerebrospinal fluid (CSF) leakage and seizure.¹ Among these, postoperative intracranial haemorrhage is a complication that often leads to critical neurological deterioration. Intracerebral haemorrhages occur most frequently, followed by subdural and, finally, epidural cases.² We present two cases with postoperative epidural haematomas (EDHs) associated with hydrocephalus and discuss the cause of haematoma development on the basis of a systematic literature review.

CASE PRESENTATION

Case 1

A 13-year-old boy presented with headaches, visual field defects and impaired consciousness. A CT scan showed obstructive hydrocephalus caused by a sellar mass lesion. To resect the sellar lesion, treat the hydrocephalus and determine the pathological diagnosis, we selected a transcallosal approach following a right frontal craniotomy with right frontal ventricular drainage. During the craniotomy, dural tenting sutures were placed around the craniotomy site. Because the intraoperative rapid diagnosis was germinoma, we selected partial resection of the

sellar lesion. A postoperative CT scan showed a multifocal EDH at the right frontotemporoparietal site. The haematoma was located adjacent to the previous craniotomy site on the ipsilateral side, although there was no regional haematoma beneath the previous craniotomy. We evacuated the EDH via a new right frontotemporoparietal craniotomy because of its 2.5 cm thickness (figure 1), although the patient showed minimal neurological deficits (Glasgow Coma Scale E3V4M6) at the time of haematoma development, in spite of the thickness of the haematoma. During the operation, we identified shrinkage of the brain with an enlarged epidural space, and the source of the bleeding was the meningeal veins, not the meningeal arteries.

Case 2

A 26-year-old man had undergone ventriculoperitoneal (VP) shunting to treat congenital hydrocephalus when he was 1.5 months old. The VP shunt was set at a low pressure and his follow-up CT scans showed slit ventricles. At this time, he presented with headaches, visual impairment and papilloedema. A CT scan showed hydrocephalus caused by ventricular catheter obstruction. He underwent replacement of the obstructive ventricular catheter. We attempted to insert a new ventricular catheter through an old burr hole, but the catheter could not pass through the choroid plexuses. Therefore, we drilled a new burr hole near the earlier one at the right parietal site, and inserted the catheter through it. A postoperative CT scan showed an EDH at the right parieto-occipital site. The haematoma was located adjacent to the previous burr hole site on the ipsilateral side, although there was no regional haematoma beneath the previous burr hole. We evacuated the EDH via a new right frontoparietal craniotomy because of its 2 cm thickness (figure 2), although the patient showed neither consciousness disturbance nor hemiparesis (Glasgow Coma Scale E4V4M6), except for persistent headaches at the time of haematoma development, in spite of the thickness of the haematoma. During the operation, we also identified shrinkage of the brain with an enlarged epidural space, and the source of the bleeding was the meningeal veins, not the meningeal arteries.

In both patients, the size of the ventricle markedly decreased by approximately 35%, 20% of

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Figure 1 (A–C) Preoperative CTs showing a sellar mass lesion with obstructive hydrocephalus. (D–F) Postoperative CTs showing a multifocal epidural haematoma (arrowheads) after a biopsy via a transcallosal approach following a right frontal craniotomy. Note that the size of the ventricle markedly decreased after the first operation (asterisk).

Evans index after the first operation. In both cases, after haematoma evacuation, the dura mater could not be lifted up to the cranial bone flap, even with multiple central tenting sutures, because the dura mater was depressed and the brain collapsed. The postoperative course was uneventful, with improvement of symptoms.

DISCUSSION

In this report, we present two cases of hydrocephalus with post-operative EDHs. In both cases, the haematomas were located adjacent to the previous craniotomy or burr hole site on the ipsilateral side. In our cases, the haematomas were thought to be associated with two causative factors. The first was

Figure 2 (A–C) Preoperative CTs showing hydrocephalus due to ventricular catheter obstruction. (D–F) Postoperative CTs showing an epidural haematoma (arrowheads) and contrast material in the ventricle and subarachnoid space after replacement of the ventricular catheter through a new burr hole near the earlier one at right parietal site (arrow). Note that the size of the ventricle markedly decreased after the first operation (asterisk).

Table 1 Clinical characteristics of case reports of postoperative epidural haematomas associated with hydrocephalus

Case No	Authors	Year	Age (years)/sex	Aetiology of hydrocephalus	Operative procedures	Site of EDH	Time from first operation to EDH	Ventricular shrinkage	Source of bleeding	Outcome
1	Yue and Mann ¹⁵	1985	16/M	Third ventricle giant cell astrocytoma	Rt P VP shunt	Rt FP*	11 days	NS	Meningeal veins	Good recovery
2	Kirkpatrick, et al ⁸	1993	12/F	Congenital hydrocephalus	Lt P VP shunt	Bil TP	1 day	Yes	NS	Good recovery
3	Kalia et al ⁷	1993	15/F	Aqueductal occlusion	Rt F VP shunt	Bil F, Lt FP	5 days	Yes	NS	Good recovery
4	Pereira et al ¹⁰	1998	33/F	Lateral ventricle cyst	Rt P VP shunt	Rt P*	4 months	Yes	NS	Good recovery
5	Pereira et al ¹⁰	1998	39/M	Sellar cyst	Rt P VP shunt	Lt F	Immediate postop	Yes	NS	Dead
6	Fujimoto et al ⁴	1999	0/M	Congenital hydrocephalus	Lt P VP shunt	Rt TP	6 weeks	Yes	Unknown	Good recovery
7	Power et al ¹¹	1999	13/M	Congenital hydrocephalus	Rt F VP shunt	Lt FTP	3 hours	Yes	NS	Good recovery
8	Hamlat et al ⁵	2004	14/M	Third ventricle oligodendroglioma	Lt F endoscopic biopsy with Lt F ventricular drainage	Lt F*	3 days	Yes	Unknown	Good recovery
9	Wolfsberger et al ¹⁴	2004	31/F	Fourth ventricle plexus papilloma	Midline suboccipital craniotomy with Rt P ventricular drainage	Lt TP, Rt PO, Rt F, Rt FB	12 hours	Yes	Unknown	Good recovery
10	Jeon et al ⁶	2006	19/M	Lateral ventricle astrocytoma	Rt P craniotomy	Rt FTP*	Immediate postop	Yes	NS	Good recovery
11	Jeon et al ⁶	2006	34/M	Lateral ventricle astrocytoma	Lt F craniotomy	Lt TP*	Immediate postop	Yes	NS	Mild deficits
12	Jeon et al ⁶	2006	66/M	Hydrocephalus	Rt P VP shunt	Rt TP*	Immediate postop	NS	NS	Good recovery
13	Pandey et al ⁹	2008	5/F	Fourth ventricle medulloblastoma	Midline suboccipital craniotomy (No drainage)	Bil F	Immediate postop	Yes	Meningeal veins	Good recovery
14	Avci et al ³	2010	9/F	Fourth ventricle dermoid cyst	Midline suboccipital craniotomy (No drainage)	Lt TP	Immediate postop	Yes	Meningeal veins	Good recovery
15	Lim et al ²	2010	9/M	Pineal gland mature teratoma	Midline suboccipital craniotomy with ventricular drainage	Bil TP	Immediate postop	Yes	NS	Good recovery
16	Seyithanoglu et al ¹³	2010	17/F	Aqueductal stenosis	Rt P VP shunt	Bil F	3 years	Yes	Meningeal veins	Good recovery
17	Roth et al ¹²	2011	3/M	Choroid plexus carcinoma	Lt Occipital craniotomy with subgaleal drainage	Bil F	Immediate postop	NS	NS	Good recovery
18	Present case 1		13/M	Sellar germinoma	Rt F craniotomy	Rt FTP*	Immediate postop	Yes	Meningeal veins	Good recovery
19	Present case 2		26/M	Congenital hydrocephalus	Rt P VP shunt revision	Rt FP*	Immediate postop	Yes	Meningeal veins	Good recovery

*The haematoma was located adjacent to the previous burr hole or craniotomy site on the ipsilateral side.

Bil, bilateral; EDH, epidural haematoma; F, fronto; FB, frontobasal; FP, frontotemporal; FTP, frontotemporoparietal; Lt, left; NS, not stated; P, parietal; PO, parieto-occipital; postop, postoperative; Rt, right; TP, temporoparietal; VP, ventriculoperitoneal.

mechanical separation of the dura mater away from the skull with oozing from the epidural space when attempting manipulation in the first operation. The second factor was associated with hydrocephalus caused by intraoperative overdrainage of the CSF, resulting in rapid shrinkage of the brain with dilation of the epidural space, a situation that may have caused dural venous bleeding. In case 1, partial resection of the sellar lesion was performed via a transcallosal approach following a right frontal craniotomy with right ventricular drainage, an approach that may have resulted in intraoperative overdrainage of the CSF. In case 2, a new burr hole was drilled near the earlier one at the right parietal site during the first operation, a procedure that may also have resulted in intraoperative overdrainage of the CSF. At the time of haematoma development, the two patients showed no neurological deterioration, in spite of the thickness of their haematomas, with CT scans showing marked ventricular size reductions, which suggests that the EDHs had developed after intraoperative overdrainage of the CSF. In both cases, because the dura mater was depressed and the brain collapsed after haematoma evacuation, the enlarged epidural space possibly alleviated the mass effect of the haematoma.

To investigate the clinical characteristics of patients with postoperative EDHs associated with hydrocephalus, we reviewed case reports of EDHs occurring as neurosurgical postoperative complications in the CT imaging era. We searched the PubMed database for all relevant articles, published from 1985 to 2011, using text word-based searches with the terms “(((epidural hematoma OR epidural hemorrhage) NOT spinal) AND ‘1985’ [Date—Publication]: ‘2011’ [Date—Publication]) AND English [Language]) AND neurosurgery”. Case reports and case series without hydrocephalus on preoperative imaging were excluded. Case reports and case series associated with post-traumatic EDHs were also excluded.

Table 1 shows 19 patients (12 males, 7 females, mean age 19.7 ± 15.6 years) who presented with non-traumatic postoperative EDHs associated with hydrocephalus.^{2–15} Initial diagnoses consisted of an intraventricular brain tumour in nine cases, an intraventricular or sellar cyst in four cases, and congenital hydrocephalus in six cases (including aqueductal stenosis/occlusion in 2 cases). All of the 19 cases showed obstructive hydrocephalus as a complication preoperatively.

To discuss the cause of postoperative EDH development, we focused attention on operative procedures, site of EDHs, the time from the first operation to EDH development, ventricular size changes after the first operation, the source of bleeding and outcomes. These 19 cases underwent operative procedures, which may have caused intraoperative overdrainage of CSF, such as transventricular tumour/cyst removal (9 cases), VP shunt insertions (9 cases), or subgaleal drainage (1 case). In 8 of these 19 cases, EDHs developed on the ipsilateral side adjacent to the previous burr hole or craniotomy sites, and in the remaining 11 cases, they developed on the contralateral side or remote from the previous burr hole or craniotomy sites. The time from the first operation to EDH development was within a day in 13 cases (68%), weeks in 3 cases (16%) and months or years in 3 cases (16%). In particular, EDHs that were detected on CT immediately after the operation accounted for 10 (53%) of the 19 cases. We assume that the EDHs in such cases developed intraoperatively rather than postoperatively. In order to avoid EDHs in patients with hydrocephalus, neurosurgeons should make every effort to prevent intraoperative overdrainage of CSF. In retrospect, the continuous oozing of blood from an epidural space was observed at the burr hole site in our case 2. If abnormal findings are encountered, including blood oozing

from an epidural space and/or marked brain shift during operation, intraoperative EDH development should be checked by ultrasonography. EDHs associated with hydrocephalus can occur in the chronic phase following the first operation. Of the 19 cases, 16 (84%) showed marked ventricular size reductions on postoperative imaging, considered to be due to intraoperative overdrainage of CSF. The source of bleeding of postoperative EDHs was confirmed as the meningeal veins in 6 (67%) of 9 cases, with a clear description of the source of bleeding. The cause of postoperative EDH development associated with hydrocephalus is considered to be that intraoperative overdrainage of CSF caused by operative procedures leads to shrinkage of the brain resulting in an enlarged epidural space, a situation that may have caused the meningeal veins to rupture. The outcomes of the EDHs were favourable if haematoma evacuation was provided in time: good recovery in 17 cases (89%), mild neurological deficits in 1 case (5%) and death in 1 case (5%).

Of the 19 cases of postoperative EDHs associated with hydrocephalus, 13 (68%) were below the age of 20. Young age may be a contributory factor. Because adhesion between the skull and the dura mater is weak, EDH tends to occur in young adults. However, subdural haematomas tend to occur in the elderly because the adhesion between the skull and the dura mater is strong.² Both of our cases were young adults, and the adhesion between the skull and the dura mater was thought to be weak. Therefore, dilation of the epidural space associated with intraoperative overdrainage of CSF may have resulted in postoperative EDH development.

Learning points

- Postoperative intracranial haemorrhage is a complication that often leads to critical neurological deterioration. Intracerebral haemorrhages occur most frequently, followed by subdural and finally by epidural haemorrhages.
- Postoperative epidural haematomas (EDH) development associated with hydrocephalus was mostly caused by intraoperative overdrainage of cerebrospinal fluid, resulting in rapid shrinkage of the brain with dilation of the epidural space, a situation that may have caused dural venous bleeding.
- Young age may be a contributory factor for postoperative EDHs. Because adhesion between the skull and the dura mater is weak, EDH tends to occur in young adults. However, subdural haematomas tend to occur in the elderly because the adhesion between the skull and the dura mater is strong.

Contributors MN and KT was responsible for conception and design, acquisition of the data, analysis and interpretation of the data, and drafting the article. All authors critically revising the article. MN was responsible for approval of the final version of the manuscript on behalf of all authors. KT and MT were involved in study supervision.

Competing interests None.

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