CASE REPORT

Spinal subdural hematoma following posterior fossa surgery

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Summary Spinal subdural hematoma (SSDH) is a rare but potentially devastating complication of cranial surgery. This study presents two cases of SSDH after posterior fossa surgery. The first case was a 44-year-old man who harbored a fourth ventricle metastatic adenocarcinoma, and the second case was a 4-year-old boy with a posterior fossa medulloblastoma. Both patients underwent suboccipital craniotomy, and SSDHs were found postoperatively. The first case underwent an additional lumbar laminectomy due to cauda equina syndrome; the second case received conservative treatment because there were no obvious neurologic deficits. Meticulous hemostasis and the avoidance of cerebrospinal fluid overdrainage may reduce the risk of SSDH after cranial surgery. Emergent decompression is warranted for SSDH in the presence of progressive neurologic deterioration.

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1. Introduction

Spinal hematoma is a rare disease entity. In the literature review and meta-analysis of 613 patients presenting with spinal hematoma reported by Kreppel et al., 1 isolated spinal subdural hematoma (SSDH) comprised only 4.1% of all spinal hematomas. SSDH related to cranial surgery is even rarer; this study presents two cases of SSDH after posterior fossa surgery.
We discuss the etiopathogenesis of SSDH and propose measures for its proper management.

2. Case reports

2.1. Case 1

A 44-year-old man, with diabetes mellitus and hypercholesterolemia, presented with a history of nausea, vomiting, and unsteady gait for 10 days. He had diplopia, nystagmus, and positive cerebellar signs, but denied recent trauma or a history of low back pain. The rest of the neurologic examination and laboratory data were unremarkable. Magnetic resonance imaging (MRI) of the brain revealed a fourth ventricle tumor.

The patient underwent uneventful tumor excision through a telovelar approach in the prone position. A drainage tube (Evacuator with Bag; Pahsco, Taipei, Taiwan) was placed in the subgaleal space and was removed soon after the drainage fluid became clear. No blood transfusion was required during the operation. No perioperative spinal procedure was carried out. The patient recovered well. The MRI of the brain 2 days after the operation did not show any cranial subdural hematoma, but some residual blood was noticed in the tumor bed. The pathologic report revealed a metastatic adenocarcinoma.

The patient complained of low back pain 3 days after the operation when he started walking. A week after the operation, sciatica and lower limb weakness (grade 4/5 of muscle power) developed, followed by acute urinary retention and saddle anesthesia within 2 days. Decreased deep tendon reflexes were found. Proprioception was not impaired. An MRI of the spine 9 days after the craniotomy revealed a blood collection in the subdural space of the entire spine. The dorsal aspect of the L5—S2 region showed the most severe compression (Fig. 1). Coagulation tests revealed no abnormalities.

Under the impression of cauda equina syndrome due to subacute SSDH, we performed an emergent L5—S1 total laminectomy for hematoma removal. The dura mater was tense and nonpulsatile. Motor-oil-like blood gushed out when we opened the dura and an underlying neomembrane was noted (Fig. 2). We drained the blood and found the arachnoid membrane to be intact. There was neither leakage of cerebrospinal fluid (CSF) nor any vascular lesion. The cytologic examination of the SSDH did not reveal malignant cells. The patient showed complete neurologic recovery within a week after the operation.

2.2. Case 2

A 4-year-old boy had suffered from dizziness, nausea, and vomiting for 3 weeks. A computed tomography scan of the brain revealed a fourth ventricle tumor with obstructive hydrocephalus. An MRI of the brain showed a heterogeneous enhancing lesion, measuring 3.8 cm × 3.5 cm × 3.7 cm, in the cerebellar vermis filling the fourth ventricle, with extension through the foramen of Luschka on the right. No evidence of CSF seeding was noted. The patient underwent a suboccipital craniotomy for tumor removal 3 days after admission. Neartotal tumor removal was achieved. The pathologic examination of the surgical specimen showed medulloblastoma with myogenic and melanotic differentiations.

Twelve days after the operation, an MRI of the spine to evaluate the possibility of spinal metastasis showed a localized fluid collection in the ventral subdural space from the T12 to S1 level (Fig. 3). The diagnosis of subacute SSDH revealed a blood collection in the subdural space of the entire spine. The dorsal aspect of the L5—S2 region showed the most severe compression (Fig. 1). Coagulation tests revealed no abnormalities.

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Figure 1  Case 1: subacute spinal subdural hematoma (SSDH) involving the whole spine. (A) Sagittal T1-weighted image of the lumbar spine showing a slightly hyperintense SSDH in the lower thoracic to sacral region, most prominent in the dorsal aspect of the L5—S2 region (arrows). (B) Axial T2-weighted image of the L5—S1 level showing dorsally located, mixed signal subacute SSDH (arrows) compressing the cauda equina ventrolaterally (arrowheads).
was made. There were no neurologic symptoms or signs. Therefore, the patient was put under close observation but with no treatment. The follow-up MRI of the spine 6 months after the operation showed complete resolution of the SSDH.

3. Discussion

SSDH is typically associated with several precipitating factors, including coagulopathy, lumbar puncture, trauma, vascular malformation, and prior spinal surgery. SSDH as a complication of posterior fossa surgery has rarely been described, even in a 10-year retrospective study.2

The spinal subdural space does not contain major blood vessels or sizable bridging veins, so rupture of the delicate network of vessels along the undersurface of the dura is unlikely to be the source of diffusely distributed SSDH. In Calhoun and Boop’s report,3 SSDH was proposed to result from a direct extension of subarachnoid hemorrhage due to ruptured spinal vessels. It was postulated that a forgotten effort in surgery or minor trauma increases both the intrathoracic pressure and the intraluminal pressure of the vessels traversing the subarachnoid space. When the CSF pressure momentarily lags behind the intravascular pressures, the vessel ruptures. If the blood clot is large enough, it ruptures through the arachnoid into the subdural space. The original blood clot is then diluted or redistributed by the CSF in the subarachnoid space and finally disappears, leaving the isolated SSDH.

However, the absorption force due to the colloidal osmotic pressure of an isolated subdural hematoma can only transport 5% of the hematoma volume through semipermeable membranes or capillaries.4 It is unlikely that this 5% increase would lead to SSDH involving the whole spine. Therefore this theory can hardly explain cases in which SSDH involves higher levels or the whole spine. In addition, if the bleeding is massive, symptoms should be acute.

It has long been recognized that air injected within the spinal subdural space readily appears in the cranial subdural space,5 which proved the continuation of the subdural space between the cranium and the spine. The morphologic

Figure 2  L5–S1 total laminectomy for hematoma removal. (A) There was no epidural hematoma, but the dura mater was tense and nonpulsatile. (B) After evacuation of the subdural hematoma, the intact subarachnoid membrane was noted.

Figure 3  Case 2: spinal subdural hematoma (SSDH) at the lumbar spine level. (A) Sagittal T1-weighted image of the lumbar spine showing a slightly hyperintense SSDH (arrows) on the ventral aspect of the lumbar region. (B) Axial T1-weighted image of the L3–L4 level showing a ventrally located subacute SSDH (arrows) compressing the cauda equina.
data also revealed that the dural border cell forms a weak cell layer at the dura-arachnoid junction that is easily disrupted.6

During cranial surgery, direct extension of the blood through the subdural space, removal of a large amount of brain parenchyma (e.g., by temporal lobectomy), or CSF overdrainage (e.g., from external ventricular drainage, a perioperative spinal procedure, or a ventriculoperitoneal shunt) facilitates the accumulation of a cranial subdural hematoma and subsequent dissection between the dura and arachnoid membrane down to the spinal subdural space under the influence of gravity.3,7 In our cases, unrecognized blood either during or after surgery might have resulted in an accumulation in the cranial subdural space. CSF overdrainage was also suspected during the operation. A 30-degree head elevation (during and after the operation) and early ambulation might promote the downward migration of the accumulated blood into the spinal subdural space, followed by SSDH.

In Case 1, we found a neomembrane beneath the spinal dura during the operation. Therefore we postulate that the evolution of SSDH is somewhat similar to that of intracranial chronic subdural hematoma. Proliferation of dural border cells produces a neomembrane. The amount of rebleeding from the neomembrane depends on the fragility of the vessels and the degree of hemolytic activity within the hematoma. Sometimes loculations and septations of the hematoma are observed, as in Case 2. Once the balance between the absorption and expansion of SSDH has been disturbed, the symptoms begin.

MRI is the modality of choice in evaluating the extension and various stages of hematomas. MRI also allows an accurate diagnosis of SSDH and differentiation from spinal epidural hematoma, which may explain the recent increase in publications relating to SSDH. For patients under conservative treatment, MRI is valuable in following up the change of the hematomas and thus predicting the outcome.

SSDH related to cranial surgery is a rare but potentially devastating condition. Most cases could be treated either conservatively or with lumbar puncture. However, prompt surgical intervention should be performed in the presence of progressive neurologic deterioration. During cranial surgery, meticulous hemostasis must be achieved, and perioperative CSF overdrainage should be avoided. Copious irrigation and isolation of the surgical area from blood contamination are essential. Finally, spinal findings should be carefully attended to, as well as cranial signs after brain surgery.

References