Intracerebral hemorrhage due to cerebral venous thrombosis during posterior cervical decompression and fusion for traumatic cervical cord injury
A case report

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Abstract
Rationale: Cerebral venous thrombosis (CVT) is a cerebrovascular disorder that causes venous infarction and intracerebral hemorrhage (ICH) with occlusion of cerebral veins, and its incidence is estimated to be 5 per 1 million people per year, accounting for 0.5% to 1.0% of all strokes. Despite advances in the recognition of CVT, the diagnosis and treatment may be difficult because of the diversity of underlying risk factors. A rare case of ICH due to CVT during surgery is described.

Patient concerns: A 69-year-old man presented to our department with a history of paralyzed extremities after a backward fall and head trauma. The patient had a history of pharyngeal cancer treated with neck dissection and radiotherapy. Computed tomography (CT) images showed continuous ossification of the posterior longitudinal ligament (OPLL) at C2–5 levels and a fracture line at the caudal end plate of the C5 body. The diagnosis was traumatic cervical cord injury, so that posterior cervical decompression and fusion was performed. Immediately after surgery, the patient developed an epileptic seizure and the disturbance of consciousness persisted. MR venography and contrast CT images showed absence of flow from the superior sagittal sinus to the transverse sinus.

Diagnoses: The diagnosis in this case was ICH due to CVT.

Interventions: The patient was treated with anticoagulation using unfractionated heparin.

Outcomes: The patient ultimately made a complete recovery from CVT.

Lessons: Although risk factors for CVT are diverse, head and neck injury, patient’s position during surgery, and postoperative radical neck dissection for pharyngeal cancer might have been the factors in this case. While the measures to prevent this disease are uncertain, early diagnosis and treatment are needed to avoid serious complications.

Abbreviations: CT = computed tomography, CVT = cerebral venous thrombosis, ICH = intracerebral hemorrhage, MRI = magnetic resonance imaging, OPLL = ossification of the posterior longitudinal ligament.

Keywords: cerebral venous thrombosis, intracerebral hemorrhage, MR venography, posterior cervical decompression and fusion, traumatic cervical cord injury

1. Introduction
Cerebral venous thrombosis (CVT) is a rare type of cerebrovascular disease, and it accounts for 0.5% to 1.0% of all strokes.[1] Thrombophilia, oral contraceptive use, infection, head and neck trauma, and surgery around the neck can cause CVT.[2] Despite the advances in the recognition of CVT in recent years, the diagnosis and treatment may be difficult because of the diversity of underlying risk factors.[3] A rare case of intracerebral hemorrhage (ICH) due to CVT during posterior cervical decompression and fusion for traumatic cervical cord injury is presented.

2. Case report
A 69-year-old man presented to our department with a history of paralyzed extremities after a backward fall and head trauma. The patient had a history of hypertension, diabetes mellitus, intracerebral hemorrhage, and pharyngeal cancer (treated with neck dissection and radiotherapy). Physical examination showed quadriplegia, with Medical Research Council power grade 1/5 at
the C6 level and below. Hypoesthesia at the C6 level and below and spinal cord injury signs, such as spasticity, extensor plantar reflexes, bilateral Hoffman’s sign, and ankle clonus, were observed. The deep tendon reflexes were hyperactive. Computed tomography (CT) images showed continuous ossification of the posterior longitudinal ligament (OPLL) at C2–5 and a fracture line at the caudal end plate of C5 body (Fig. 1A). Sagittal images of cervical spine magnetic resonance imaging (MRI) with the short tau inversion recovery (STIR) sequence showed signal changes of the cervical cord at C3–5 and signal change of the vertebral bodies at C5 and 6 (Fig. 1B).

The diagnosis in this case was traumatic cervical cord injury due to cervical instability. A crown halo vest was placed on the same day as the injury to stabilize the C5 and C6 level. Three days later, posterior cervical decompression and fusion (C2–7) were performed (Fig. 2). The operation time was 4 hours 11 minutes,

Figure 1. CT image (A). Ossification of the posterior longitudinal ligament (OPLL) at C2–5 and a fracture line at the caudal end plate of C5 body (arrow). Sagittal MR image of the cervical spine with STIR sequence (B) showing signal changes of the cervical spine at C3–5 and of vertebral body signals at C5, 6. CT = computed tomography, STIR = short tau inversion recovery.

Figure 2. Lateral (A) and AP (B) cervical postoperative plain radiographs. Posterior cervical decompression with instrumented fusion from the C2–7 levels is performed.
without complications such as dural tear and spinal fluid leakage. Cervical CT was performed for the evaluation of instrument installation under general anesthesia. It was seen that there was no implant malposition, so the patient was transferred to an intensive care unit for recovery. When the anesthesiologist tried to decannulate the patient during spontaneous breathing, the patient started to have an epileptic seizure, and the disturbance of consciousness persisted. Therefore, head CT was performed immediately under general anesthesia, and left subcortical hemorrhage was seen (Fig. 3). A neurosurgeon was consulted, and head MRI and contrast-enhanced CT were performed. MRI showed an infarction near the hemorrhagic focus. MR venography and contrast CT showed the absence of flow from the superior sagittal sinus to the transverse sinus (Fig. 4). The diagnosis in this case was ICH due to CVT, and anticoagulation with unfractionated heparin was performed. The patient's consciousness level improved 5 days after the onset day, and decannulation was performed. Head CT 15 days after onset showed improvement of the subcortical hemorrhage (Fig. 5). The patient ultimately made a complete recovery from CVT. The patient has provided informed consent for publication of the case.

3. Discussion
CVT is a cerebrovascular disorder that causes venous infarction and ICH with the occlusion of cerebral veins, and its incidence is estimated to be 5 per 1 million people per year, accounting for 0.5% to 1.0% of all strokes. A systematic review including 8829 patients with CVT from 74 series with more than 40 subjects found an average age of 32.9 years, and 64.7% were women, but only 8.2% were aged ≥65 years. To the best of our knowledge, there have been no reports of ICH due to CVT during surgery.

Prior medical conditions (e.g., thrombophilia, inflammatory bowel disease), transient situations (e.g., pregnancy, dehydration, infection), selected medications (e.g., oral contraceptives), and unpredictable events (e.g., head trauma) are some predisposing factors. At least one risk factor can be identified in 85% of patients with CVT, and multiple factors are identified in some patients. Despite advances in the recognition of CVT in recent years, the diagnosis and treatment can be difficult because of the diversity of underlying risk factors. Given the diversity of the causes and presenting scenarios, CVT may commonly be encountered not only by neurologists and neurosurgeons, but
also by emergency physicians, internists, oncologists, hematologists, obstetricians, pediatricians, and family practitioners. Minami et al reported a case in which the patient's position (slightly flexed neck position and prone position) during surgery could reduce deep venous-flow velocity, and venous blood might stagnate, contributing greatly to thrombogenicity. Wüstenberg et al reported a case in which, after unilateral radical neck dissection, the venous blood left the brain mainly via the venous system of the other side of the neck and the ipsilateral collateral veins. Although the patient in the present case was not of an age susceptible to CVT, he had risk factors such as head trauma and cervical spine surgery. Furthermore, those factors of the slightly flexed neck position, prone position, and postoperative radical neck dissection for pharyngeal cancer might have caused CVT.

The confirmation of the diagnosis of CVT depends on the demonstration of thrombi in the cerebral veins or sinuses. Three imaging techniques can be used: MRI with MR venography, CT with CT venography, and angiography. In general, MRI is more sensitive for the detection of CVT than CT at each stage after thrombosis. In particular, MR venography is recommended as the imaging test for the evaluation of suspected CVT.

Approximately 30% to 40% of patients with CVT present with ICH. In patients with lobar ICH of otherwise unclear origin or with cerebral infarction that crosses typical arterial boundaries, imaging of the cerebral venous system should be performed. One study created and validated a risk score model to predict a poor outcome after CVT. The risk score model ranged from 0 (lowest risk) to 9 (highest risk), and a cutoff of 3 points indicated a higher risk of death or dependency at 6 months. Two points were assigned for the presence of malignancy, coma, or thrombosis of the deep venous system, and 1 point for male sex, presence of decreased level of consciousness, or ICH. In the present case, male sex, presence of a decreased level of consciousness, and ICH were observed, so that this case scored 3 points and was classified in the serious group. Another multivariate analysis also indicated that coma and cerebral hemorrhage were significantly associated with a poor outcome. In a meta-analysis of 1180 patients with CVT, the mean 30-day mortality rate was 5.6%. The main causes of acute death were neurologic, and the most frequent mechanism was transtentorial herniation. However, 65.7% of patients with CVT recover completely at discharge. Careful follow-up is needed because 4.4% of patients with CVT develop recurrence. Although the present case was in the high-risk group of CVT during surgery, early diagnosis and treatment achieved a good outcome. Unfortunately, no reports are available on prophylactic measures for CVT, but it is necessary to recognize that the factors of head and neck injury, patient's position during surgery, and postoperative radical neck dissection for pharyngeal cancer might have caused CVT.

Furthermore, early diagnosis and treatment are necessary to avoid serious complications.

4. Conclusions

A case of ICH due to CVT during posterior cervical decompression and fusion for traumatic cervical cord injury was presented. Although the risk factors for CVT are diverse, head and neck injury, patient's position during surgery, and postoperative radical neck dissection for pharyngeal cancer might have been the factors in this case.

While prophylactic measures for this disease are uncertain, early diagnosis and treatment are needed to avoid serious complications.
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