Remote Cerebellar Hemorrhage after Lumbar Spinal Surgery

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Remote cerebellar hemorrhage (RCH) is rare but potentially lethal as a complication of spinal surgery. We recently experienced a case of RCH in a 61-year-old man who showed mental deterioration after lumbar spinal surgery. There was dural tearing with subsequent cerebrospinal fluid (CSF) loss during the surgery. Brain computed tomography scan revealed cerebellar hemorrhage, 3rd and 4th ventricular hemorrhage and pneumocephalus. He underwent suboccipital craniectomy and hematoma removal. The most important pathomechanism leading to RCH after spinal surgery has been known to be venous bleeding due to caudal sagging of cerebellum by rapid leak of large amount of CSF which seems to be related with this case. Dural repair and minimizing CSF loss after intraoperative dural tearing would be helpful to prevent postoperative RCH.

KEY WORDS: Remote cerebellar hemorrhage · Spinal surgery · Dural tear · Cerebrospinal fluid leakage.

INTRODUCTION

Remote cerebellar hemorrhage (RCH), which develops distant to the site of surgery, is rare but potentially lethal as a complication of supratentorial craniotomy or spinal surgery\(^8\). The incidence of RCH after supratentorial surgery was reported between 0.2% and 4.9%\(^{18,23}\). However, RCH after spinal surgery was reported less than that after supratentorial surgery\(^8\). All the reported cases of RCH after spinal surgery involved intraoperative dural tearing and cerebrospinal fluid (CSF) leakage, which are not rare in spinal operations\(^6\). Brain computed tomography (CT) or magnetic resonance image (MRI) allows immediate diagnosis of this complication\(^5\). However, the exact pathophysiology and etiology are still unknown.

Previous studies have shown that potentially serious problems such as pseudomeningocele, CSF fistula formation, meningitis, arachnoiditis with subsequent chronic pain, nerve root injury, brainstem herniation, cerebellar dysfunction, and RCH are all related to dural tears and CSF leakage after spinal surgery\(^1,3,9\).

Health Insurance Review and Assessment Service of Korea (http://www.hira.or.kr) reported in 2007 that 149,525 spine surgeries were performed in South Korea. The rates of intraoperative dural tear were reported as 3.5% for primary discectomy, 8.5% for spinal stenosis surgery, and 13.2% for revision discectomy\(^21\). Considering the reported incidence rate of incidental dural tear during spinal surgery and the reported number of annual spine surgeries in South Korea, there seems to be larger number of RCH, detected or undetected, than that we expect.

We report a case in which RCH occurred after spinal surgery with a review of relevant literature regarding the pathomechanism and preventive management of RCH.

CASE REPORT

A 61-year-old man presented with pain in his lower back and both legs. Lumbar CT and MRI revealed herniated discs and spinal stenosis at L3-4 and L4-5 (Fig. 1). He had no history of hypertension, dura matter (DM), hypercoagulable state, recent infection, or trauma. The patient underwent partial hemilaminectomy and discectomy at local spine clinic. DM was damaged intraoperatively and was sutured in watertight fashion. There was no specific problem such as perioperative hypertension or hypoxia and...
the patient awoke normally from anesthesia. Next morning
the patient complained of headache and nausea, and then
his consciousness was decreased. Brain CT scan was checked
immediately, revealing cerebellar hemorrhage at vermis and
bilateral hemisphere, intraventricular hemorrhage in the
3rd and 4th ventricle, and pneumocephalus (Fig. 2).

The patient was transferred to our hospital. On arrival,
his consciousness was deep drowsy, but soon dropped into
stuporous state. CT scan checked at our hospital showed
slightly increased hematoma and aggravated hydrocephalus.
Laboratory studies, including platelet count, prothrombin
time, and partial thromboplastin time, were within normal
ranges.

He underwent an emergency operation including subo-
cipital craniectomy, hematoma removal, duroplasty, and
CSF diversion via extraventricular drainage from right
lateral ventricle to prevent hydrocephalus. His conscious-
ness recovered to drowsy state after 2 weeks and transferred to
rehabilitation department with mild cerebellar signs at 1.5
months after hematoma removal.

**DISCUSSION**

Postoperative remote intracranial hemorrhage can occur
in supratentorial, cerebellar, epidural, or subdural compart-
ment. Some authors reported RCH as a delayed compli-
cation of spinal surgery. Chadduck reported the first RCH case in 1981,
which occurred after cervical laminectomy and total of 14 cases have been reported to date (Table 1).

RCH has characteristic image findings. RCH usually extends to folia
and vermis close to tentorium in the upper part of cerebellum, which makes
typical CT finding of alternating curvilinear hyperdense (blood) and hypo-
dense (cerebellum). The finding seen on MRI or CT is described as the
zebra sign' refers to the horizontal curvilinear configuration
of the hemorrhage in between the cerebellar folia.

There are several theories on the pathological mechanisms for RCH. Most theories are related with involvement
of venous system, which can be supported by the following facts. First, hemorrhage is located in the upper
vermis and cerebellar sulci, where the cerebellar draining veins are located. Second, almost all the cases of RCH were
bilateral whereas arterial bleeding tended to be unilateral. Speediness and large amount of CSF loss may be required
for cerebellar hemorrhage to occur because RCH is, although
possible, extremely rare after lumbar puncture in which the
CSF loss is slow and small in amount. Recently, only two
cases of RCH after lumbar drainage in patients with normal
pressure hydrocephalus have been reported. Several reports
indicated that caudal sagging of cerebellum by rapid leak of
large amount of CSF would be the pathomechanism
leading to RCH after spinal surgery. The 'cerebellar sag'
can cause venous occlusion or arterial infarction, which can
be followed by reperfusion hemorrhage or venous bleeding
secondary to increased venous pressure. However, RCH
involves area larger than the territory of a single vein and
usually does not demonstrate edema or cerebellar swelling,
which is not conforming exactly to the cerebellar sag
theory. The precise mechanism of RCH is still unknown.

However, most authors seem to agree on two facts: RCH is

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**Fig. 1.** Lumbar computed tomography axial images at L3-4 (A), L4-5 (B) reveal narrowed spinal canal. Lumbar magnetic resonance myelography shows dural
sac indentations at L3-4, L4-5 (C). Postoperative lumbar spine X-ray AP view shows laminectomy defect at L3-5 (in black circle) (D).

**Fig. 2.** A non-contrast computed tomography scan demonstrates acute hemorrhage in the cerebellar
vermis and both hemispheres (A), a streaky and curvilinear bleeding pattern with blood in the cerebellar
sulci facing the tentorium (zebra sign) (arrow) (B), intraventricular hemorrhage at 3rd ventricle, and
profound pneumocephalus (C).
of venous origin and a result of intraoperative or postoperative loss of CSF. There are also some possible risk factors for RCH, preexisting coagulopathy, postoperative arterial hypertension, and obstruction of jugular vein by extreme head rotation\(^{15}\). Perioperative patient positioning is believed to lead to RCH after cranial surgery\(^{9,20}\). It is known that, in patients who undergo pterional craniotomy, hyperextension of the neck and subsequent head rotation can cause obstruction of the ipsilateral jugular vein\(^{20}\). While this type of hemorrhage can occur after any type of spinal surgery, the role of patient positioning in the development of RCH was reported to be insignificant in the literature\(^{9}\).

The RCH patient can be treated either with surgery or conservatively. Treatment of RCH depends on the neurological status of the patient. Small RCH can be managed medically and followed with serial imaging; however, large RCH with signs of brainstem compression must require immediate surgical decompression\(^{1,8,9,11}\). Compression of fourth ventricle and subsequent non-communicating hydrocephalus can be managed with CSF diversion procedures\(^{1-11}\). The prognosis of RCH patients is usually favorable with mild and transient neurological dysfunction\(^{2}\).

We suggest that great care must be taken to prevent dural injury during spinal surgery or try to minimize CSF loss when dura tears by head-down position and immediate closure. When large volume of CSF has been lost intraoperatively or postoperatively, the possibility of RCH should be considered in any patient with unexplainable neurological deterioration.

**CONCLUSION**

The most important pathomechanism leading to RCH after spinal surgery is known to be venous bleeding due to caudal sagging of cerebellum by rapid leak of large amount of CSF which seems to be related with this case. Dural repair and minimizing CSF loss after intraoperative dural tearing would be helpful to prevent postoperative RCH.

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