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Case Report

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[4]. 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[3]. 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

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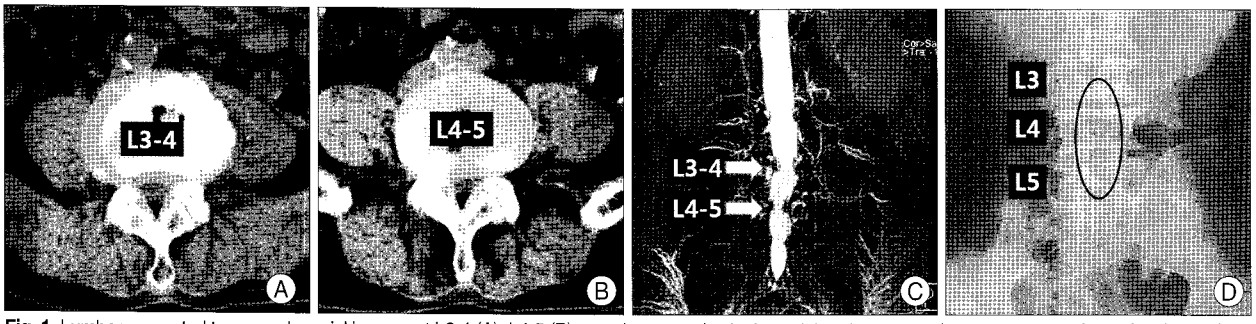

Fig. 1. Lumbar computed tomography axial images at L3-4 (A), L4-5 (B) reveal narrowed spinal canal. Lumbar magnetic resonance myelography shows dural sac indentations at L3-4, L4-5 (C). Postoperative lumbar spine X-ray AP view shows laminectomy defect at L3-5 (in black circle) (D).

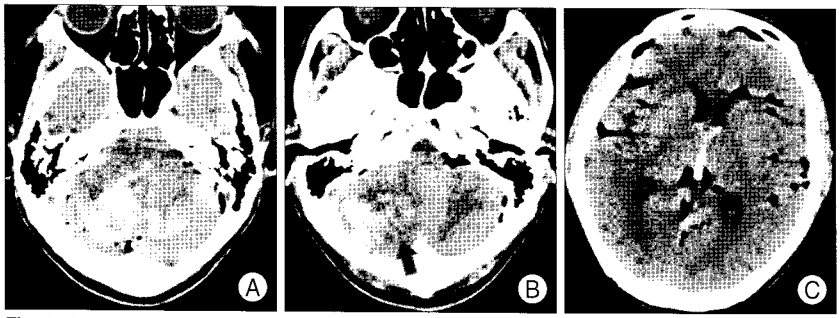

Fig. 2. A non-contrast computed tomography scan demonstrates acute hemorrhage in the cerebellar vermis and both hemispheres (A), a streaky and curvilinear bleeding pattern with blood in the cerebellar sulci facing the tentorium (zebra sign) (arrow) (B), intraventricular hemorrhage at 3rd ventricle, and profound pneumocephalus (C).

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 suboccipital craniectomy, hematoma removal, duroplasty, and CSF diversion via extraventricular drainage from right lateral ventricle to prevent hydrocephalus. His consciousness 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 compartment[15]. Some authors reported RCH as a delayed complication of spinal surgery. Chadduck[8] 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 hypodense (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[5,7].

There are several theories on the pathological mechanisms for RCH. Most theories are related with involvement of venous system[9,10,12,23,24], 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[12]. 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[2]. 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[9,10]. 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[9,10]. 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[9]. The precise mechanism of RCH is still unknown[4,9]. However, most authors seem to agree on two facts : RCH is

Table 1. The reported cases of remote cerebellar hemorrhage after spinal surgery

No.	Authors (Year)	Primary pathology	Location	Age/Sex	Hemorrhage location	Treatment
1	Chadduck[8]	Spinal stenosis	Cervical	59/M	Left Cbll	SOC + EVD
2	Mikawa et al.[16]	Revision of fusion	Cervical	75/M	Bilateral Cbll	SOC + EVD
3	Andrews and Koci[1]	Spinal scoliosis	Lumbar	36/M	Bilateral Cbll	EVD
4	Göbel et al.[11]	Postdiscectomy syndrome	Lumbar	40/F	Right Cbll	SOC + EVD
5	Göbel et al.[11]	Spondylolisthesis	Lumbar	57/F	Bilateral Cbll	EVD
6	Satake et al.[19]	Intramedullary tumor	Cervical	62/M	Cbll	SOC
7	Morandi et al.[17]	Tumor (schwannoma)	Cervical	34/M	Right Cbll + Left Temporal	Conservative
8	Friedman et al.[10]	Herniated disc	Thoracic	43/M	Right Cbll	Conservative
9	Friedman et al.[10]	Spinal stenosis	Lumbar	56/M	Bilateral Cbll	Conservative
10	Thomas et al.[22]	Tumor	Thoraco-Lumbar	38/F	Left Cbll + Right Temporal	Conservative
11	Karaeminogullari et al.[13]	Spinal stenosis	Lumbar	73/F	Left Cbll	SOC + AVM removal
12	Brockmann et al.[4]	Spondylolisthesis	Lumbar	52/M	Bilateral Cbll	EVD
13	Konya et al.[15]	Herniated disc + Spinal stenosis	Lumbar	48/F	Bilateral Cbll	Conservative
14	Calisaneller et al.[6]	Spondylolisthesis	Lumbar	67/F	Bilateral Cbll	Conservative
15	Current case	Herniated disc + Spinal stenosis	Lumbar	61/M	Bilateral Cbll	SOC + EVD

AVM : arteriovenous malformation , Cbll : cerebellum, EVD : extraventricular drainage, SOC : suboccipital craniectomy

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[7].

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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