Intracranial hemorrhage following lumbar spine surgery

Mahmoud Reza Khalatbari · Iraj Khalatbari ·
Yashar Moharamzad

Received: 19 June 2011 / Revised: 24 September 2011 / Accepted: 28 January 2012 / Published online: 16 February 2012
© Springer-Verlag 2012

Abstract

Background Intracranial hemorrhage is a serious but rare complication of spinal surgery, which can occur in the intracerebral, cerebellar, epidural, or subdural compartment.

Purpose To describe patients with intracranial hemorrhage after lumbar spinal surgery and present clinical and diagnostic imaging findings.

Methods In this retrospective study, medical records of 1,077 patients who underwent lumbar spinal surgery in our tertiary referral neurosurgery center between January 2003 and September 2010 were studied. The original presentations of the patients before the surgical intervention were herniated lumbar disc, spinal canal stenosis, spondylolisthesis, lumbar spinal trauma, and lumbar spine and epidural tumor. The operations performed consisted of discectomy, multiple level laminectomy, stabilization and fusion, lumbar instrumentation, and lumbar spinal and epidural tumor resection.

Results Four cases developed intracranial hemorrhage including acute subdural hematoma (one case), epidural hematoma (one case), and remote cerebellar hemorrhage (two cases). The clinical and diagnostic imaging characteristics along with treatments performed and outcomes of these four patients are described and the pertinent literature regarding post-lumbar spinal surgery intracranial hemorrhages is reviewed.

Conclusion Though rare, intracranial hemorrhage can occur following lumbar spinal surgery. This complication may be asymptomatic or manifest with intense headache at early stages any time during the first week after surgery. Dural tear, bloody CSF leakage, focal neurologic

symptoms, and headache are indicators of potential intracranial hemorrhage, which should be considered during or following surgery and necessitate diagnostic imaging.

Keywords Intracranial hemorrhage · Lumbar spine surgery · Remote cerebellar hemorrhage · Subdural hematoma · Epidural hematoma

Introduction

Spine surgery is linked with a wide range of intraoperative complications including wrong-level surgery, nerve root lesion, vascular injury, and dural tearing [1, 2]. Dural tear during spinal surgery is not uncommon, with reported incidence rates of 1–17% [1]. Most common causes of dural tear are thin dura, adhesion of dura, surgical technique, and so on. This complication may cause postural headache, nerve root or brainstem herniation, cerebellar dysfunction, or intracranial hemorrhage [1–5]. Intraoperative cerebrospinal fluid (CSF) loss following dural tear may occur unexpectedly due to reasons such as spine surgery, myelography, ventriculoperitoneal shunt placement, epidural anesthesia, spine trauma, etc. Subsequent development of intracranial and/or intraspinal hypotension may result in postural headache usually lasting for 5 days, nerve root or brainstem herniation, cerebellar dysfunction, photophobia, mental status alteration, and seizure in affected patients [4]. One of the rare fatal complications following CSF leak is formation of intracranial hematoma in different locations including acute subdural hematoma (SDH), epidural hematoma (EDH), and remote cerebellar hemorrhage (RCH) [1–5].

Previous case reports on SDH agree that development of negative pressure following CSF leakage and caudal movement of the brain with resultant tension of bridging

M. R. Khalatbari (✉) · I. Khalatbari · Y. Moharamzad
Department of Neurosurgery, Arad Hospital, Somayeh St.,
Between Dr. Shariati and Bahar Ave., 1445613131 Tehran, Iran
e-mail: mrkhalatbari@hotmail.com

veins could have a pathophysiologic explanation [4]. While RCH has also been reported in rare instances, we did not find any published report on EDH after spine surgery.

In this report, the authors describe four patients who developed various forms of intracranial hemorrhage after lumbar spinal surgery. The possible pathophysiological mechanisms of these conditions are discussed and the pertinent literature is reviewed.

Patients and methods

Between January 2003 and September 2010, 1,077 patients who had undergone lumbar spinal surgery were included in the study. The patients were operated in our hospital, which is a major tertiary referral center for patients with neuro-surgical conditions. The required data were gathered using medical records of the patients and comprised primary

Fig. 1 **a** Sagittal T2-weighted MRI of the lumbar spine showing a large extruded L4–L5 intervertebral disc. **b** Axial non-contrast brain CT demonstrates cerebellar hemorrhage and zebra sign (alternating hyperdense (blood) and hypodense (cerebellum) curvilinear, slightly irregular stripes). **c** Sagittal T1-weighted MRI of the brain which shows cerebellar hemorrhage. **d** Sagittal T1-weighted MRI of the brain showing tonsillar herniation and brain sagging

clinical presentation, demographic data, radiologic findings, postoperative complications, and treatments applied for intracranial hemorrhage.

The original presentations of patients before the surgery were herniated lumbar disc, spinal canal stenosis, spondylolisthesis, lumbar spinal trauma, and lumbar spine and epidural tumor. The surgical interventions done for the patients were discectomy, multiple level laminectomy, stabilization and fusion, lumbar instrumentation, and lumbar spinal and epidural tumor resection.

Brain computed tomography (CT) scan and/or magnetic resonance imaging (MRI) were performed in all cases with intraoperative tearing of dura or postoperative CSF leakage and in patients with postoperative headache, nausea, vomiting, or neurological symptoms.

Results

Intracranial hemorrhage was diagnosed in four patients, remote cerebellar hemorrhage (RCH) in two cases, acute intracranial SDH in one case, and acute EDH in one case. It should be noted that no coagulopathy, bleeding disorder, arterio-venous malformation (based on histopathology report of clot samples sent to the pathology laboratory), intraoperative anesthetic complications, or any other systemic disease was detected before surgeries according to laboratory (complete blood count, prothrombin time, thromboplastin time, bleeding time, and clotting time) and physical examinations performed routinely for spinal surgery candidates in our center. Only the second patient had essential hypertension, which was under control with antihypertensive medications.

The first case who had RCH after lumbar discectomy was a 53-year-old previously healthy man who presented with the chief complaints of low back pain and bilateral L5 radiculopathy for 1 month. Lumbar MRI revealed a large central L4–L5 disc herniation. He was healthy and had no history of bleeding disorder. Discectomy at L4–L5 level was performed in prone position. After removal of a large extruded disc fragment, a small amount of CSF escaped. There was no obvious dural tear. A subfascial Hemovac drain was inserted, which is a legal requirement and is routinely performed in such patients in our hospital. When the patient awoke from anesthesia, he was neurologically intact. At 8 h after surgery, he complained of severe headache, began vomiting, became drowsy and then lost consciousness. The Hemovac drain contained 550 ml of serous fluid tinged with blood, which was consistent with CSF.

The drain was immediately removed and the patient was intubated. Brain CT scan revealed superior cerebellar hemorrhage and zebra sign (radiologic finding including

streaky bleeding pattern as a result of blood spreading in the cerebellar sulci [6]) with acute hydrocephalus as a result of tonsillar herniation. MRI of the brain showed bilateral hemorrhagic infarction of the cerebellar hemispheres and brain sagging (Fig. 1a–d). External ventricular drainage (EVD) was inserted and the patient was positioned in the Trendelenburg's position in neurosurgical ICU. After 10 days, he gained his consciousness and at 2 weeks after surgery, he was discharged with mild gait ataxia. At 3 months postoperatively, he was neurologically intact.

The second patient who developed RCH after lumbar laminectomy was a 75-year-old man. He presented with low back pain and neurogenic claudication and L5 radiculopathy for 6 months. His past medical history was remarkable only for hypertension. Preoperative coagulation studies were normal. Lumbar MRI revealed severe lumbar canal stenosis from L1 to L5.

He underwent L1–L5 laminectomy in the prone position. Intraoperatively, a dural tear occurred and about 150 ml of CSF escaped before dural repair. Otherwise, the operation was uneventful. Postoperatively, the emergence from anesthesia was delayed and his level of consciousness did not improve. Brain CT scan was performed at 3 h after surgery and showed vermis and bilateral cerebellar hemorrhagic infarction and blood in the fourth ventricle with acute hydrocephalous (Fig. 2). The Hemovac drained contained about 100 cc of bloody CSF. A ventriculostomy was placed, the Hemovac drain was removed and he was

Fig. 2 Axial non-contrast brain CT showing the fourth ventricular hemorrhage and bilateral cerebellar infarction

Fig. 3 **a** Right frontoparietal subdural hematoma with mild brain shift is seen on axial T1-weighted brain MRI. **b** Coronal T1-weighted brain MRI showing a right parietal subdural hematoma. **c** Axial T1-weighted brain MRI revealed SDH resolution

admitted to ICU. He died 16 days postoperatively due to pulmonary complications and sepsis.

The patient who had acute SDH was a 34-year-old previously healthy female who presented with L5 radiculopathy for 4 weeks. She underwent an L4–L5 discectomy for a large central extruded disc fragment. There was no dural tear intraoperatively, but the Hemovac drain contained 200 ml of bloody CSF 24 h after surgery. She was discharged from the hospital the day after the operation with resolution of her symptoms.

Five days after operation, she presented once more to the hospital complaining of an intense headache, which had started earlier on the third postoperative day, and mild left facial palsy. Brain MRI on day 5 showed a right frontoparietal SDH (Fig. 3a, b). On lumbar MRI, there was no pseudomeningocele. She underwent conservative therapy with bed rest, analgesic and dexamethasone. The patient's

symptoms improved and after 8 days she was neurologically intact. Brain MRI on day 9 was normal (Fig. 3c). She was discharged and on further follow-up after 6 months, she was in good general condition with no neurologic symptom/sign.

The patient who had acute EDH was a 29-year-old man who presented with a 4-week history of L5 radiculopathy and low back pain. He was found to have an extruded L4–L5 disc herniation. The past medical history was unremarkable and coagulation studies before the surgery were within normal range. He underwent an L4–L5 discectomy in the prone position. Intraoperatively, a small dural tear happened at the right L5 root shoulder and about 100 ml of CSF escaped before dural suturing.

Postoperatively, the Hemovac drain contained 200 ml of bloody CSF at 24 h. The day after operation,

Fig. 4 **a** Axial T1-weighted brain MRI demonstrates a large epidural hematoma of the left posterior parietal region. **b** Coronal T1-weighted brain MRI shows a left parietal epidural hemorrhage compressing the underlying brain

he complained of progressive headache followed by vomiting. Brain MRI showed left parietal EDH compressing the adjacent brain tissues (Fig. 4a, b). A left parietal craniotomy was performed and the hematoma was evacuated. The clot was sent for histopathology examination, and the result was hematoma with no vascular pathology. The postoperative course was uneventful and at the 4-year follow-up, he was in good general condition without any neurologic symptom/sign.

Discussion

RCH is probably a manifestation of cerebellar venous hemorrhage and infarction. Cerebellar “sag” which is a result of excessive CSF leakage has been proposed to cause stretching and occlusion of the superior vermal veins. In patients with insufficient venous collaterals, this may cause venous infarction, subsequently leading to hemorrhagic transformation [2, 6–15] as occurred in our first and second cases. Another explanation is a rise in transmural venous pressure associated with CSF drainage and intracranial hypotension [2]. According to the experience with RCH after spinal surgery to date (30 cases), it appears that this type of hemorrhage can occur after any type of spinal surgery, in which large-volume CSF loss has occurred during or after surgery, regardless of body positioning [2, 6–15]. RCH should be suspected in any patient with unexplained deterioration of consciousness or with delayed emergence from anesthesia following spine surgery complicated by dural tear and CSF leak [2, 6–15]. The clinical presentation ranges from transient cerebellar and brainstem dysfunction to large hematoma causing obstructive hydrocephalus [2, 6–15]. The presence of the zebra sign, bilateral cerebellar involvement, and documented CSF hypotension can help define the diagnosis and avoid unnecessary workup [6, 12, 13].

A meticulous review of the literature showed that only seven cases of intracranial SDH have been reported after spinal surgery including the presented case [1, 3, 4, 16]. The mechanism responsible for subdural hematoma is persistent CSF leakage through the dura mater after dural tear; subsequent cerebral hypotension with caudal displacement of the shifting brain structures in turn causes subdural veins to stretch and tear [1, 3, 4, 16]. In our first and second cases, RCH and brain sag occurred when large amounts of CSF was lost within a short period of time, during which time collateral venous drainage would not have had time to develop, in contrast to SDH in our third case that occurred with continuous and slower leakage of CSF over a longer period of times.

Intracranial EDH is extremely rare after spinal surgery [15]. To the best of our knowledge, this is the first report of intracranial EDH after lumbar discectomy complicated by dural tearing. The mechanism responsible for EDH in our case remains unclear. Intraoperative position may play a role in which the posterior parietal region was the highest point and sudden intracranial hypotension led to dural detachment from the inner skull and hematoma formation.

Most cases with SDH can be treated conservatively with bed rest, hydration and analgesic as in case 3, but in selected cases hematoma evacuation with spinal dural defect repair is necessary [1, 3, 4, 16]. Most cases with RCH can be treated conservatively with immediate

removal of subfascial drain, complete bed rest, and Trendelenburg position and external ventricular drainage, but in some cases surgical removal of hematoma or re-exploration of the surgical site may be needed [2, 6–15]. EDH should be treated with hematoma evacuation [5].

Conclusion

Intracranial hemorrhage is a rare complication that can occur because of dural rupture and CSF loss during or after spinal surgery. The surgeon must be especially alert to intracranial bleeding when CSF leak was observed or suspected, and any patient with declining mental status or unusual headache and cranial nerve deficits after spine surgery should immediately be investigated with CT or MRI to exclude intracranial hemorrhage.

Conflict of interest None.

References

1. Beier AD, Soo TM, Claybrooks R (2009) Subdural hematoma after microdiscectomy: a case report and review of the literature. *Spine J* 9:E9–E12
2. Hahsidade H, Kamimura M, Nakagawa H, Takahara K, Uchiyama S (2008) Cerebellar hemorrhage after spine surgery. *J Orthop Sci* 13:150–154
3. Burkhard PR, Duff JM (2000) Bilateral subdural hematoma following routine lumbar discectomy. *Headache* 40:480–482
4. Sciubba D, Kretzer RM, Wang PP (2005) Acute intracranial subdural hematoma following a lumbar CSF leak caused by spine surgery. *Spine* 30:E730–E732
5. Surash S, Bhargava D, Tayagi A (2009) Bilateral extradural hematoma formation following excision of a thoracic intradural lesion: case report. *J Neurosurg Pediatr* 3:137–140
6. Brockmann MA, Nowak G, Reusche E, Russlies M, Petersen D (2005) Zebra sign: cerebellar bleeding pattern characteristic of cerebrospinal fluid loss. *J Neurosurg* 102:1159–1162
7. Fernandez-Jara J, Jorge-Blanco A, Carro-Martinez AI, Ferreiro-Arguelles C, Fernandex-Gallardo JM, Romero-Coronado J (2011) Remote cerebellar hemorrhage after lumbar spinal surgery. *Emerg Radiol* 18:177–180
8. Friedman JA, Ecker RD, Piepgras DG, Duke OA (2002) Cerebellar hemorrhage after spinal surgery: report of two cases and literature review. *Neurosurgery* 50:1361–1364
9. Gul S, Kalayci M, Acikgoz B (2010) A rare complication of spinal surgery: cerebellar hemorrhage. *Turkish Neurosurg* 20:413–417
10. Khong P, Day MJ (2009) Spontaneous cerebellar haemorrhage following lumbar fusion. *J Clin Neurosci* 16:1673–1675
11. Ladehoff M, Zachow D, Koch C, Nowak G, Echelmeyer A, Arnold H, Giese A (2005) Cerebellar hemorrhage and tension pneumocephalus after resection of a Pancoast tumor. *Acta Neurochir (Wien)* 147:561–564
12. Lehmann P, Saliou G (2011) Remote cerebellar haemorrhage. *Eur J Radiol Extra* 77:e29–e33
13. Morofuji Y, Tsunoda K, Takeshita T, Hayashi K, Kitagawa N, Suyama K et al (2009) Remote cerebellar hemorrhage following thoracic spinal surgery: case report. *Neurol Med Chir (Tokyo)* 49:117–119
14. Nam TK, Park SW, Min BK, Hwang SN (2009) Remote cerebellar hemorrhage after lumbar spinal surgery. *J Korean Neurosurg Soc* 46:501–504
15. Sasani M, Sasani H, Ozer AF (2010) Bilateral late remote cerebellar hemorrhage as a complication of a lumbo-peritoneal shunt applied after spinal arteriovenous malformation surgery: case report. *J Spinal Cord Med* 33:77–79
16. Kuhn J, Hofman B, Knitelius HO (2005) Bilateral subdural haematoma and lumbar pseudomeningocele due to a chronic leakage of liquor cerebrospinalis after a lumbar discectomy with the application of ADCON-L gel. *J Neurol Neurosurg Psychiatry* 76:1031–1033