



Review Article

Cerebellar hemorrhage as a complication of spine surgery

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ABSTRACT

Background: The association between remote cerebellar hematoma (RCH) and spinal surgery is poorly understood and rarely reported. We present seven cases of RCH after spinal surgery.

Methods: Seven patients were diagnosed with RCH utilizing computed tomography and/or magnetic resonance, between 2012 and 2016. Their clinical presentations, imaging data, treatment modalities, and outcome were analyzed. There were five females and two males with an average age of 55.8 ± 8.4 years. The age of onset ranged from 43 to 67 years and the time to clinical presentation ranged from 3 h to 5 days. Patients presented with: diplopia/strabismus (one patient), dysphagia/urinary incontinence (one patient), respiratory arrest (one patient), meningismus (one patient), and dysarthria (two patients), along with other symptoms/signs.

Results: Three patients were successfully managed without surgery, two required external ventricular drainage, and two were treated with posterior fossa decompression plus ventriculostomy. Four patients recovered completely, two showed mild residual deficits at discharge, while one expired 7 days postoperatively.

Conclusion: RCH is an uncommon and underdiagnosed complication of spine surgery. It should be suspected when intracranial symptoms occur after spinal procedures.

Keywords: Case report, cerebrospinal fluid leak, remote cerebellar hemorrhage, spinal surgery

INTRODUCTION

“Remote cerebellar hemorrhage” (RCH) is a rare complication of spinal surgery and may have catastrophic consequences. Cevik *et al.* reported an incidence of 0.08% among 2444 lumbar surgeries.^[2] The most likely etiology is an intraoperative cerebrospinal fluid (CSF) leak resulting in excessive intraoperative CSF drainage I, downward cerebellar traction, and stretching/occlusion of the cerebellar veins resulting in hemorrhagic venous infarction.^[4,6,11]

Here, we present seven cases of RCH after spine surgery that included an intraoperative dural fistula.

METHODS

Patient population

We retrospectively reviewed the clinical presentation, operative notes, imaging data, treatment modalities, and outcomes of seven patients with intraoperative CSF fistulas resulting in RCH following spinal surgery (2012–2016).

Literature review

We reviewed the literature regarding RCH after spinal surgery that included a CSF fistula; 65 articles involving 70 patients were analyzed, to which we now add seven cases [Table 1].

RESULTS

The clinical presentations, operations, operative findings, and outcomes for these seven patients are summarized in Table 2.

DISCUSSION

RCH is an infrequent complication of spine surgery. RCH more likely occur in patients with intraoperative CSF fistulas (93%) draining large volumes of CSF.^[4,5,8,11]

Chaddock^[3] described the RCH syndrome following the performance of a cervical laminectomy with durotomy performed in the sitting position. Other cases involve surgery and dural fistulas at all spinal levels. Sturiale *et al.*^[9] suggested that the more common involvement of the lumbar spine is due to the higher rates of degenerative diseases in the segment. Moreover, the use of pedicle screws may increase the risk of occult fistulas.^[9] In our series, six operations involved the lumbar spine while one patient had thoracic surgery.

Etiology of RCH

The majority of the RCH is attributed to venous hemorrhagic infarction,^[10] i.e., descent of cerebellum with stretching/occlusion

of superior cerebellar veins and temporary occlusion.^[1,6,11] The common bilateral cerebellar involvement reinforces the venous theory, as arterial bleeds are typically unilateral.^[1]

Time of onset of RCH

About 50% of RCH occur 24 h after surgery.^[9] As most patients do not undergo a routine postoperative brain magnetic resonance imaging, the true incidence may be higher.^[4,9] In one study (2006),^[7] the RCH occurred between 16 and 120 h postoperatively. In our series, the RCH usually presented between the 1st and the 3rd postoperative day (range 3 h–5 days).

Clinical findings for patients who develop RCH

Patients ranged in age from the fourth to the sixth decade. Of these, 72% were women. One paper^[9] suggested an average age of 57.6 years of age, and a male/female ratio of 2:3.

Symptoms of RCH

The symptoms of RCH depend on the extent and severity of the RCH. These include uniformly, headache, altered level of consciousness, and cerebellar signs often including dysarthria.^[9] In this series of seven patients, all had a headache, 71% had cerebellar signs, 57% had altered level of consciousness, 28% had vomiting, and 14% had meningismus. Mild neurological deficits such as ataxia and neurogenic bladder were present in the other patients.

Outcomes of RCH following CSF fistula during spinal surgery

Outcomes vary due to several factors including extent of bleeding, intracerebellar component, underlying disease, amount of time before action is taken and presence of further complications.^[6] The risk of acute obstructive hydrocephalus and brainstem compression is directly related to the size of the hemorrhage and cerebellar ischemia. In our series, four of seven patients recovered (57%), while one expired. These findings are similarly reflected in literature.^[9]

Table 1: Patients status after spine surgery who were found to have a remote cerebellar hemorrhage.

Age/sex	Surgery	Clinical presentation	Surgical management	Outcome
45/F	Recurrent lumbar disc herniation	Headache, vomiting, diplopia, left convergent strabismus, cerebellar signs	EVD	Mild ataxia, left dysmetria
67/M	Spinal extradural metastasis	Headache, dysarthria, drowsiness	EVD	No deficit*
54/M	L5–S1 discal herniation	Headache, dizziness, dysphagia, dysarthria, urinary incontinence, cerebellar signs	No	No deficit
58/F	T5–T7 intradural extramedullary schwannoma	Headache, breathing arrest, conscious level deterioration	Posterior fossa decompression+ventriculostomy	Death
43/F	L4–L5 and L5–S1 PLIF	Headache, meningism	No	No deficit
63/F	L4–L5 and L5–S1 PLIF	Headache, sweating, skin pallor, drowsiness, cerebellar signs	Posterior fossa decompression+ventriculostomy	Ataxia
61/F	Lumbar fixation	Headache, cerebellar signs	No	No deficit

F: Female, M: Male, PLIF: Posterior lumbar interbody fusion, EVD: External ventricular drainage. *Death due to systemic neoplastic disease after 1 year of spinal surgery

Table 2: Summary of literature about Cerebellar Hemorrhage after spine surgery.

Author	Age/sex	Clinical presentation	Surgery	Surgical management	Outcome
Chaddock 1981	59/M	-	Cervical laminectomy	PFD+EVD	Residual deficit
Mikawa et al. 1994	75/M	-	Cervical arthrodesis revision	PFD+EVD	No deficit
Andrews and Koci 1995	36/M	Deterioration mental status	Lumbar scoliosis	EVD	Quadriplegia
Gobel et al. 1999	40/F	-	Arthrodesis	PFD+EVD	No deficit
Gobel et al. 1999	57/F	-	Arthrodesis	EVD	Residual deficit
Satake et al. 2000	62/M	Headache, nausea, dysarthria, breathing arrest	Cervical ependymoma	PFD	Ataxia
Elmaci et al. 2000	35/F	Confusion	thoracolumbar decompression, removal of a disc+fusion	No	No deficit
Morandi et al. 2001	34/M	Dysarthria	C7-T1 laminectomy	No	No deficit
Friedman et al. 2002	43/M	Dysarthria, ataxia	T9-T10 discectomy	No	Dysarthria, gait ataxia
Friedman et al. 2002	56/F	Headache, vomiting, dysarthria, upper-extremities ataxia	L3-S1 laminectomy+fixation	No	Mild dysarthria and ataxia
Thomas et al. 2002	38/F	Headache, nausea	T11-L1 Laminectomy	No	No deficit
Farag et al. 2005	43/F	Drowsy	Lumbosacral fusion revision	EVD	Diplopia
Karaeminogullari et al. 2005	73/F	LOC	L2-L5 fusion	PFD	Ataxia
Nakazawa et al. 2005	74/F	Drowsiness, hemiplegia	Cervical intradural extramedullary tumor	No	Gait ataxia
Brockmann et al. 2005	52/F	Comatose state	L5-S1 fusion	EVD	Death
Konya et al. 2006	48/F	Dysarthria, headache, vomiting	L3-L5 fusion	No	No deficit
Chalela et al. 2006	62/F	Unresponsiveness, downward gaze deviation	L3-L5 laminectomy+fusion	Ventriculostomy	No deficit
Ozturk et al. 2006	23/F	LOC	Rod placement for thoracolumbar scoliosis	No	No deficit
Sakaura et al. 2006	36/M	Lethargy, slurred speech, CS	Atlantoaxial neurinoma	No	Mild CS
Calisaneller et al. 2007	67/F	Headache, gait ataxia	L4-L5-S1 fixation	No	No deficit
Cornips et al. 2007	48/F	Headache, dysphasia, LOC	T8-T9 microdiscectomy	No	Death
Sagrera and García 2008	55/F	Confusion, mydriasis, nystagmus, dysmetria, Babinski sign	L5-S1 discectomy	EVD	No deficit
Bernal-Garcia et al. 2008	64/F	Headache, nausea, vomiting	Lumbar drainage	No	No deficit
Bernal-Garcia et al. 2008	77/F	Headache, vomiting	Lumbar drainage	No	No deficit
Hashidate et al. 2008	85/F	Dysarthria, headache, vomiting, LOC	Extradural MPNST T5-T6	Hematoma evacuation	Residual deficit
Nam et al. 2009	61/M	Headache, nausea, LOC	L3-L4 and L4-L5 discectomy	PFD+EVD	Drowsy state
Cevik et al. 2009	79/F	Headache	L4 laminectomy L5 foraminectomy	No	No deficit
Cevik et al. 2009	68/F	Headache, vomiting	L4-S1 Fusion	No	No deficit
Enel et al. 2009	51/F	Headache, drowsiness, bradypnea	Lumbar fusion	EVD	Death
Khong and Jerry Day 2009	70/F	Drowsiness	L5-S1 fusion	EVD	Able to walk, cognitively well
Morofuji et al. 2009	51/M	Headache, nausea	T9-T10 laminectomy	PFD, EVD	No deficit
Pallud et al. 2009	73/F	Headache, confusion LOC	L5-S1 fusion	EVD, PFD	No Deficit
Ulivieri et al. 2009	53/M	??	Lumbar microdiscectomy	No	Improved??
Lehman and Saliou 2010	70/F	Headache	Spinal stenosis	-	-
Sasani et al. 2010	47/F	Headache, confusion	T2-L2 laminotomy due to AVM+LPS	No	No deficit
Kim et al. 2010	56/F	Headache, dysarthria, confusion	Lumbar Fusion	PFD+Ventriculostomy, later VPS	Unable to walk
Yang et al. 2011	56/F	Nausea, mental confusion	L3-L4 fusion	PFD	Ataxia, aphasia

(Contd...)

Table 2: (Continued)

Author	Age/sex	Clinical presentation	Surgery	Surgical management	Outcome
Navalpotro <i>et al.</i> 2011	58/F	Headache, impaired consciousness	L5-S1 laminectomy	No	-
Bowers <i>et al.</i> 2011	64/F	Tonic-clonic seizures, headache, impaired consciousness	S1-S2 laminectomies+resection of recurrent sacral chordoma	EVD	No deficit
Fernandez-Jara <i>et al.</i> 2011	58/F	Headache, vomiting, and diminished consciousness.	L5-S1 laminectomy+transpedicular fixation	No	No deficit
You <i>et al.</i> 2012	63/M	Headache	L3-L5 fusion	No	No
Hempelmann and Mater 2012	61/F	Melancholy	T1-T4 laminectomy intradural metastasis+thoracic epidural hematoma	No	No deficit
Hempelmann and Mater 2012	69/F	Headache, nausea	L3-L4 fusion	No	No deficit
Hempelmann and Mater 2012	62/F	Mental confusion, headache	L2-L4 fusion	No	No deficit
Khalatbari <i>et al.</i> 2012	53/M	Headache, vomiting, LOC	L4-L5 discectomy	EVD	No deficit
Khalatbari <i>et al.</i> 2012	75/M	LOC	L1-L5 laminectomy	Ventriculostomy	Death
Lee <i>et al.</i> 2012	63/F	LOC, seizure, headache	L3-L4 fusion	No	No deficit
Takahashi <i>et al.</i> 2012	69/F	Mental confusion	C3-C7 Laminoplasty	No	Hemianopsia
Kaloostian <i>et al.</i> 2013	45/M	LOC	Cervical corpectomy+fusion	No	No deficit
Kaloostian <i>et al.</i> 2013	63/M	Somnolence	Laminectomy+fusion	No	No deficit
Kaloostian <i>et al.</i> 2013	77/M	Mental confusion	T11-S1 instrumentation	EVD	Cognitive deficit, Impaired functional mobility
Kaloostian <i>et al.</i> 2013	64/F	LOC	L1-S1 fusion	No	Death
Kaloostian <i>et al.</i> 2013	81/F	Somnolence	L4-L5 fusion	Ventriculostomy+PFD	Death
Yoo <i>et al.</i> 2013	66/M	Headache, dizziness, nausea, vomiting, horizontal nystagmus	L1-L2 laminotomy	PFD	No deficit
Huang <i>et al.</i> 2013	33/M	Drowsiness, seizures	Anterior cervical discectomy and fusion of C3-5	No	No deficit
Huang <i>et al.</i> 2013	68/M	Drowsiness	Anterior and posterior cervical decompression	No	No deficit
Huang <i>et al.</i> 2013	49/M	Dysarthria	C3-C7 laminectomy (intramedullary tumor)	No	No deficit
Huang <i>et al.</i> 2013	59/F	Consciousness deterioration, seizure	C2-5 laminectomy+posterolateral fusion	PFD	No deficit
Huang <i>et al.</i> 2013	55/M	dysarthria and consciousness deterioration	C2-5 laminectomy+posterolateral fusion+RDL	PFD	Weakness of the extremities
Cavanilles-Walker <i>et al.</i> 2013	65/F	Sudden mental deterioration	L2-L5 decompression+postero-lateral fusion+TLIF L3-4 and L4-5	Hematoma evacuation+EVD	Slight dysmetria
Morimoto <i>et al.</i> 2014	46/M	Consciousness deterioration	Occipital cervical surgery for os odontoideum	No	No deficit
Malio <i>et al.</i> 2014	75/M	Headache, dysarthria	L4-L5 laminectomy	EVD	Mental confusion
Royon <i>et al.</i> 2014	45/F	Headache, impaired consciousness, mydriasis	L3-L4 Discectomy	PFD	GOS 5
Ma <i>et al.</i> 2014	59/F	-	C2-C5 Schwannoma	PFD?	-
Castelnuovo <i>et al.</i> 2014	66/M	Confusion, ataxia, horizontal nystagmus, myoclonus	Descompressive laminectomy+L1-S1 posterior arthrodesis	No	-
Kim <i>et al.</i> 2015	60/F	Headache, dizziness, ataxia, diplopia, dysarthria	L4-L5 laminectomy+SPO L4-L5 L5-S1 discectomy L3- 4-5-S1 pedicle-screw fixation	No	No deficit

(Contd...)

Table 2: (Continued)

Author	Age/sex	Clinical presentation	Surgery	Surgical management	Outcome
Haller <i>et al.</i> 2015	58/F	Headache, vomiting, dysarthria, diplopia	removal of L4–S1 (PSIF) implants and L3–L4 laminectomy with PSIF	No	No deficit
Watanabe <i>et al.</i> 2015	79/F	Clouding of consciousness, headache, ataxia	Schwannoma resection+L3–L5 fusion	Hematoma evacuation	No deficit
Suzuki <i>et al.</i> 2015	57/F	dizziness, nausea, and vomiting	Intradural extramedullary tumor resection and T1–T5 pedicle screw fixation	No	Slight ataxia
Pham <i>et al.</i> 2016	50/F	Left 6 th cranial nerve palsy	T10–L2 intradural extra- medullary mass+T10–L2 PSIF	No	No deficit
Worm <i>et al.</i> 2017	45/F	Headache, vomiting, diplopia, left convergent strabismus, CS	Recidivant Lumbar disc Herniation	EVD	Mild ataxia, left dysmetria
Worm <i>et al.</i> 2017	67/M	Headache, dysarthria, drowsiness	Spinal extradural metastasis	EVD	No deficit
Worm <i>et al.</i> 2017	54/M	Headache, dizziness, dysphagia, dysarthria, urinary incontinence, CS	L5–S1 discal herniation	No	No deficit
Worm <i>et al.</i> 2017	58/F	Headache, breathing arrest, LOC	T5–T7 intradural extramedullary schwannoma	PFD+ventriculostomy	Death
Worm <i>et al.</i> 2017	43/F	Headache, meningism	L4–L5 L5–S1 PLIF	No	No deficit
Worm <i>et al.</i> 2017	63/F	Headache, sweating, skin pallor, drowsiness, CS	L4–L5 L5–S1 PLIF	PFD+ventriculostomy	ataxia
Worm <i>et al.</i> 2017	61/F	Headache, CS	Lumbar fixation	No	No deficit

EVD: External ventricular derivation, PFD: Posterior fossa decompression, LOC: Loss of consciousness, LPS: Lumboperitoneal shunt, MPNST: Malignant peripheral nerve sheath tumor, VPS: Ventriculoperitoneal shunt, CS: Cerebellar signs, GOS: Glasgow outcome scale, M: Male, F: Female, SPO: Smith-Petersen osteotomy, PSIF: Posterior spinal instrumented fusion, PLIF: Posterior lumbar interbody fusion, TLIF: Transforaminal lumbar interbody fusion, RDL: Releasing dentate ligaments

Nonsurgical versus surgical management

Small hematomas can be managed conservatively,^[9] while large hematomas are causing a mass effect at the posterior fossa often require surgical decompression.^[3,9] Most of our patients required surgery, one needed external ventricular drainage, one needed craniectomy plus duroplasty, two required both procedures, and three of them were treated conservatively due to small hematomas and no consciousness deterioration.

CONCLUSION

RCH should be considered in patients who have unexpected neurological deterioration after spinal surgery involving an intraoperative CSF fistula. Early recognition of RCH and confirmation with neuroimaging investigation allows for quick proper management, and better outcomes.

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Conflicts of interest

There are no conflicts of interest.

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