Cerebellar hemorrhage as a complication of spine surgery

Paulo Valdeci Worm1,2, Amauri Dalla-Corte2, Albert Vincent Berthier Brasil1, Gerson Perondi1, Ericson Sfreddo2, Antônio Delacy Martini Vial1, Guilherme Gago1, Pablo Ramon Fruett da Costa1

1Department of Neurological Surgery, Sao Jose Hospital, Santa Casa Hospital Complex, 2Department of Neurosurgery, Cristo Redentor Hospital, Porto Alegre, RS, Brazil.

E-mail: Paulo Valdeci Worm - paulowormnec@gmail.com; Amauri Dalla-Corte - dalacorte@gmail.com; Albert Vincent Berthier Brasil - albertvbr@gmail.com; Gerson Perondi - g3perondi@gmail.com; Ericson Sfreddo - ericsonsfreddo@gmail.com; Antonio Delacy Martini Vial - admvial@gmail.com; *Guilherme Gago - guilherme.gago@gmail.com; Pablo Ramon Fruett da Costa - pablorfcosta@hotmail.com

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.[3,6,11]

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]

Chadduck[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.[1,4,6,11] 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.[4,5] 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                        |
|-----------------------------|---------|--------------------------------------------|----------------------------------------------|---------------------|--------------------------------|
| Chadduck 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 epidermoma                      | 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                      |
| Karamanogullari 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       | 36/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                    | Venticulostomy       | 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                         |
| Sagarra and Garcia 2008     | 55/F    | Confusion, mydriasis, nystagmus, dysmetria, Babinski sign | L5–S1 discectomy                           | EVD                 | No defect                     |
| 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                          | 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, bradympnea           | 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 Salieu 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+EVD             | Unable to walk, later VPS     |
| 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 et al. 2011        | 58/F    | Headache, impaired consciousness              | L5–S1 laminectomy                            | No                  | -                              |
| Bowers et al. 2011            | 64/F    | Tonic-clonic seizures, headache, impaired consciousness | S1–S2 laminectomies+resection of recurrent sacral chordoma | EVD                 | No deficit                     |
| Fernandez-Jara et al. 2011    | 58/F    | Headache, vomiting, and diminished consciousness. | L5–S1 laminectomy+transpedicular fixation    | No                  | No deficit                     |
| You et al. 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 deficit          | No                             |
| Hempelmann and Mater 2012     | 69/F    | Headache, nausea                              | L3–L4 fusion                                 | No                  | No deficit                     |
| Navalpotro et al. 2011        | 62/F    | Mental confusion, headache                    | L2–L4 fusion                                 | No                  | No deficit                     |
| Khalatbari et al. 2012        | 53/M    | Headache, vomiting, LOC                        | L4–L5 discectomy                             | EVD                 | No deficit                     |
| Khalatbari et al. 2012        | 75/M    | LOC                                           | L1–L5 laminectomy                            | Ventrileostomy      | Death                          |
| Lee et al. 2012               | 63/F    | LOC, seizure, headache                         | L3–L4 fusion                                 | No                  | No deficit                     |
| Takahashi et al. 2012         | 69/F    | Mental confusion                              | C3–C7 Laminoplasty                           | No                  | Hemianopsia                    |
| Kaloostian et al. 2013         | 45/M    | LOC                                           | Cervical corpectomy+fusion                   | No                  | No deficit                     |
| Kaloostian et al. 2013         | 63/M    | Somnolence                                    | Laminection+fusion                           | No                  | No deficit                     |
| Kaloostian et al. 2013         | 77/M    | Mental confusion                              | T11–S1 instrumentation                       | EVD                 | Cognitive deficit, Impaired functional mobility |
| Kaloostian et al. 2013         | 64/F    | LOC                                           | L1–S1 fusion                                 | No                  | Death                          |
| Kaloostian et al. 2013         | 81/F    | Somnolence                                    | L4–L5 fusion                                 | Ventriculostomy+PFD | Death                          |
| Yoo et al. 2013                | 66/M    | Headache, dizziness, nausea, vomiting, horizontal nystagmus | L1–L2 laminotomy                            | No                  | No deficit                     |
| Huang et al. 2013             | 33/M    | Drowsiness, seizures                           | Anterior cervical discectomy and fusion of C3–5 | No                  | No deficit                     |
| Huang et al. 2013             | 68/M    | Drowsiness                                    | Anterior and posterior cervical decompression | No                  | No deficit                     |
| Huang et al. 2013             | 49/M    | Dysarthria                                    | C3–C7 laminectomy (intramedullary tumor)     | No                  | No deficit                     |
| Huang et al. 2013             | 59/F    | Consciousness deterioration, seizure           | C2–5 laminectomy+posterolateral fusion       | PFD                 | No deficit                     |
| Huang et al. 2013             | 55/M    | Dysarthria and consciousness deterioration     | C2–5 laminectomy+posterolateral fusion+RDL   | PFD                 | Weakness of the extremities   |
| Cavanilles-Walker et al. 2013  | 65/F    | Sudden mental deterioration                    | L2–L5 decompression+postero-lateral fusion+TLIF L3–4 and L4–5 | Hematoma evacuation+EVD | Slight dysmetria              |
| Morimoto et al. 2014          | 46/M    | Consciousness deterioration                     | Occipital cervical surgery for os odontoideum | No                  | No deficit                     |
| Ma et al. 2014                 | 59/F    | Confusion, ataxia, horizontal nystagmus, myoclonus | C2–C5 Schwannoma                             | PFD?                | -                              |
| Castronovo et al. 2014         | 66/M    | Confusion, ataxia, horizontal nystagmus, myoclonus | Descompressive laminectomy+L1–S1 posterior arthrodesis | No                  | -                              |
| Kim et al. 2015                | 60/F    | Headache, dizziness, ataxia, diplopa, dysarthria | L4–L5 laminectomy+SPO L4–L5 L5–S1 discectomy L3–4–5–S1 pedicle-screw fixation | No                  | No deficit                     |
Table 2: (Continued)

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

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Bernal-Garcia LM, Cabezudo-Artero JM, Ortega-Martinez M, Fernández-Portales I, Ugarriza-Echebarrieta LF, Pineda-Palomo M, et al. Remote cerebellar hemorrhage after lumbar spinal fluid drainage. Report of two cases and literature review. Neurocirugia (Astur) 2008;19:440-5.
2. Cevik B, Kirbas I, Cakir B, Akin K, Teksam M. Remote cerebellar hemorrhage after lumbar spinal surgery. Eur J Radiol 2009;70:7-9.
3. Chadduck WM. Cerebellar hemorrhage complicating cervical laminectomy. Neurosurg 1981;9:185-9.
4. Friedman JA, Ecker RD, Piepgras DG, Duke DA. Cerebellar hemorrhage after lumbar spinal surgery: Report of two cases and literature review. Neurosurgery 2002;50:1361-3.
5. Gobel F, Heidecke V, Hube R, Reichel H, Held A, Hein W. Cerebellar hemorrhage as an early complication of spinal operations. 2. Case reports and review of the literature. Z Orthop Ihre Grenzgeb 1999;137:2-6.
6. Karaeminogullari O, Atalay B, Sahin O, Ozalay M, Demirors H, Tuncay C, et al. Remote cerebellar hemorrhage after a spinal surgery complicated by dural tear: Case report and literature review. Neurorsurg 2005;57 Suppl 1:215.
7. Konya D, Ozgen S, Pamir MN. Cerebellar hemorrhage after spinal surgery: Case report and review of the literature. Eur Spine J 2006;15:95-9.
8. Ma X, Zhang Y, Wang T, Li G, Zhang G, Khan H, et al. Acute intracranial hematoma formation following excision of a cervical
subdural tumor: A report of two cases and literature review. Br J Neurosurg 2014;28:125-30.
9. Sturiale CL, Rossetto M, Ermani M, Baro V, Volpin F, Milanese L, et al. Remote cerebellar hemorrhage after spinal procedures (part 2): A systematic review. Neurosurg Rev 2016;39:369-76.
10. Yasargil MG, Yonekawa Y. Results of microsurgical extra-intracranial arterial bypass in the treatment of cerebral ischemia. Neurosurg 1977;1:22-4.
11. Yoshida S, Yonekawa Y, Yamashita K, Ihara I, Morooka Y. Cerebellar hemorrhage after supratentorial craniotomy - Report of three cases. Neurol Med Chir (Tokyo) 1990;30:738-43.

How to cite this article: Worm PV, Dalla-Corte A, Brasil AV, Perondi G, Sfreddo E, Vial AD, et al. Cerebellar hemorrhage as a complication of spine surgery. Surg Neurol Int 2019;10:85.