

Deep Cervical Artery as a Source of Bleeding in Postoperative Spinal Epidural Hematoma: A Case Report

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The source of bleeding in postoperative spinal epidural hematoma (pSEH) is often unclear. We describe a surgical case of pSEH in which the source of bleeding was thought to be the deep cervical artery (DCA). A 67-year-old man underwent C₃ laminectomy, C₄₋₆ unilateral open door laminoplasty, and C₇ partial laminotomy for cervical spondylotic myelopathy. Intraoperatively, arterial hemorrhage from a distal branch of the right DCA was observed while drilling the lateral end of the C₃ lamina, so electrocoagulation hemostasis was performed. A suction drain was used to obliterate the epidural space, and it was removed 22 h postoperatively. The patient suddenly felt posterior cervical pain 26 h postoperatively. Computed tomography demonstrated a huge epidural hematoma at the C₃₋₆ level. The hematoma was evacuated 4 h after the onset of symptoms. Active bleeding was not seen intraoperatively. The patient was discharged on postoperative day 13, and no symptoms caused by the epidural hematoma remained. Considering the findings of the first operation, we concluded that a branch of the DCA might have been the source of bleeding in pSEH, and the site of the drain and removal procedure might have been one of the causes of bleeding. It is important to be aware of the DCA as a blood vessel because it requires careful attention when dissecting the semispinalis cervicis or performing operations for hemostasis before wound closure.

Keywords: postoperative spinal epidural hematoma, deep cervical artery

Introduction

Postoperative spinal epidural hematoma (pSEH) is a serious complication of spinal surgery. There are several reports about the risk factors for pSEH,¹⁻³ but much about the source of bleeding remains unclear. Of 400 cases of cervical laminoplasty, we describe our experience with only one surgical case of pSEH (approximately 0.25%) for which the

source of bleeding was thought to be the deep cervical artery (DCA), and the site of the drain and removal procedure were considered to have possibly caused the bleeding.

Case Report

The patient was a 67-year-old man with no noteworthy medical or drug history. He was admitted for surgical treatment of cervical spondylotic myelopathy that was diagnosed based on pain around the right shoulder and right C₅ paralysis. Preoperative magnetic resonance imaging showed cervical kyphosis and dural sac compression centered at the C₄₋₆ level (Fig. 1A).

Laminoplasty was performed using a posterior approach. While drilling the lateral end of the C₃ lamina, the anterior portion of the right semispinalis cervicis was damaged, and arterial hemorrhage from a distal branch of the right DCA was observed (Figs. 2A and 2B). Electrocoagulation hemostasis was performed at both the distal branch of the right DCA and semispinalis cervicis. Ultimately, C₃ laminectomy, C₄₋₆ unilateral open door laminoplasty, and C₇ partial laminotomy were performed. One epidural drain was inserted, and the tip was placed at the C_{3/4} level (Fig. 1B). The drain was connected to a suction system, and the wound was closed after confirming that injection and suction of physiological saline at the wound site were performed effectively.

Systolic blood pressure was about 120 mmHg when the patient was extubated postoperatively. Pain management was good with patient-controlled analgesia, but systolic and diastolic blood pressures gradually increased; thus, the blood pressures were lowered using a continuous intravenous injection of nitroglycerin (2 mg/h). Discharge from the drain gradually decreased and became serious. There were no signs of surgical site bleeding or subcutaneous bleeding, so the drain was removed 22 h postoperatively.

The patient felt sudden posterior cervical pain upon rising from bed 26 h postoperatively. Although the nervous system symptoms did not worsen, exudative hemorrhage from the wound and subcutaneous bleeding around the surgical site were observed. Computed tomography (CT) showed an epidural hematoma posterior to the C₃₋₆ level (Figs. 1C and 1D). Spouting hemorrhage from the surgical site was observed when the staples were removed in the patient's hospital room. Subsequently, the patient was transported to the operating theater for hematoma evacuation and bleeding control. The hematoma was evacuated 4 h after the onset of symptoms. Active bleeding was not seen intraoperatively, and the site of bleeding could not be identified. One epidural drain was

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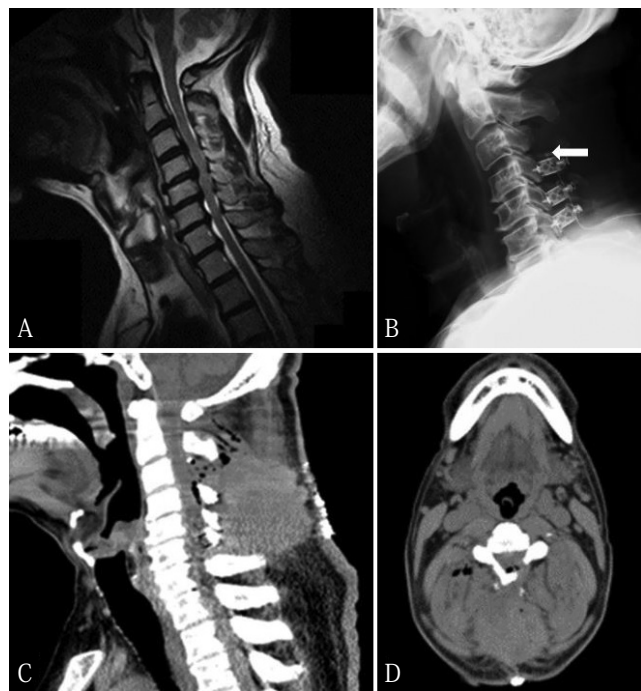


Fig. 1 Perioperative imaging study. (A) Preoperative sagittal T₁-weighted magnetic resonance imaging scan shows cervical kyphosis and dural sac compression centered at the C₄₋₆ level. (B) Plain radiograph on postoperative day 1. The tip of the drain is placed at the C₃₋₄ level (arrow). (C and D) Computed tomography image on postoperative day 1. Sagittal image shows the spinal epidural hematoma at the C₃₋₆ level (C). Axial image shows the C_{3/4} level (D).

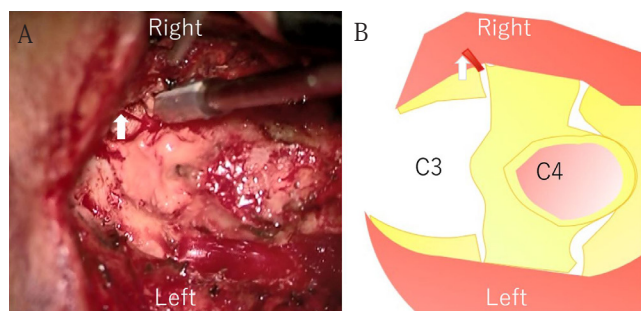


Fig. 2 Intraoperative microscopic view. (A) Active bleeding is shown from the right deep cervical artery (arrow). (B) Schema of A. The red line shows spouting bleeding.

inserted, and the surgical procedure was completed. Systolic blood pressure was decreased within the target of 140 mmHg or below. The epidural drain was removed on postoperative day 3 without applying negative pressure to it.

The patient progressed without a recurrent increase in hematoma size or worsening of neurological symptoms. Pain around the right shoulder and right C₅ paralysis gradually improved, and there were no wound issues. He was discharged on postoperative day 13.

Discussion

Wang et al.'s⁴⁾ meta-analysis showed that the incidence of pSEH after cervical surgery was 1.1%. To date, several

reports suggested that the source of bleeding in pSEH is the split muscle wall,⁵⁾ epidural venous plexus,⁶⁾ or radicular artery.⁷⁾ However, much about the source of bleeding in pSEH remains unclear, and only one report suggested that the source of bleeding in pSEH is outside of spinal canal.⁵⁾ There are no reports about the DCA being the source of bleeding in pSEH after posterior cervical surgery⁵⁻¹³⁾ (Table 1).

This case suggests the following two points. First, the DCA can be a possible source of bleeding in pSEH. Second, the site of the drain and removal procedure may inadvertently cause pSEH.

Herein, it was found that the DCA can be a source of bleeding in pSEH. The joint capsules of the zygapophyseal joints, the synovial membranes with their villi and folds receive their blood supply from branches of the DCA, the vertebral artery, the ascending pharyngeal artery, and the uppermost intercostal artery.¹⁴⁾ The DCA diverges at the costocervical trunk and is located lateral to the C₃₋₆ lamina.¹⁵⁾ Vascular supply at the C_{3/4} level is shown in Fig. 3 modified from Lang.¹⁴⁾ The DCA anastomoses with branches of the vertebral artery and the occipital artery at the lateral end of lamina. In this case, arterial hemorrhage from a distal branch of the right DCA was observed during the initial surgery. An evident source of hemorrhage could not be confirmed during hematoma evacuation. However, it was clear from CT image

Table 1 Review of previously reported cases of postoperative spinal epidural hematoma after posterior cervical surgery

Author	Number of cases	Active bleeding intraoperatively	Operative level
Neo et al. ⁵⁾	1	Artery (Split muscle wall) (Not described about the name of artery)	C ₃ -T ₁
Ohba et al. ⁷⁾	1	Artery (Radicular artery)	C ₃₋₆
Goldstein et al. ⁶⁾	8	Unknown (Hypothesized that epidural venous plexus)	C ₄₋₆ C ₃₋₆ C ₃₋₇ C ₂₋₄ C ₃₋₆ C ₂₋₄ C ₂₋₅ C ₃₋₅
Lee et al. ⁸⁾	1	Unknown	C ₃₋₇
Yi et al. ⁹⁾	1	Unknown	C _{5/6}
Yin et al. ¹⁰⁾	1	Unknown	C ₄₋₇
Ohba et al. ⁷⁾	2	1. Unknown 2. Unknown	C ₂₋₇ C ₃₋₇
Anno et al. ¹¹⁾	4	1-4. Unknown	Not described
Rasekhi et al. ¹²⁾	1	Unknown	C ₄₋₇
Tomii et al. ¹³⁾	1	Unknown	C ₃₋₇

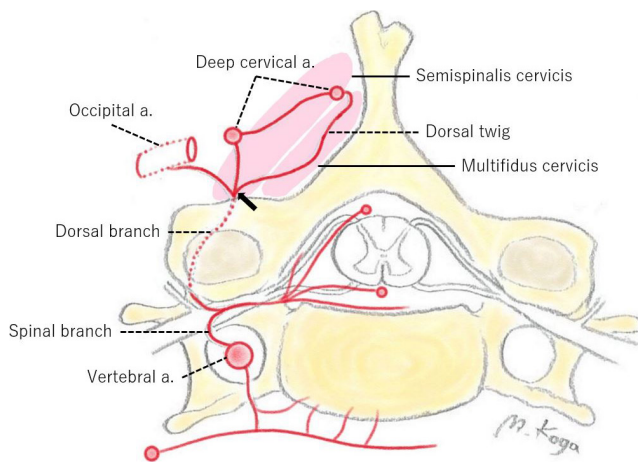


Fig. 3 Vascular supply at the C₁ level (modified from Lang¹⁴). The deep cervical artery anastomoses with branches of the vertebral artery and the occipital artery at the lateral end of lamina. The damaged point is shown on semispinalis cervicis (arrow).

on postoperative day 1 that the responsible blood vessel was outside of the spinal canal. Thus, considering the anatomy of the DCA, arterial hemorrhage from the right DCA, which was observed during the initial surgery, and the location of the hematoma, the DCA can be a source of bleeding in pSEH. Therefore, operators should be aware of the DCA as one blood vessel that is vulnerable to damage caused by posterior cervical surgery.

We also found that the site of the drain and removal procedure may inadvertently cause pSEH. A previous study suggested the possibility of hemorrhage from the drain placement site.¹⁶ When the erector spinae muscles are damaged while drilling the lamina, the bleeding point of the damaged artery is buried in the muscle. Therefore, it is difficult to perform complete hemostasis at the damaged artery. As the tip of the drain was placed near the damaged DCA during the initial surgery, it is possible that friction between the tip of the drain and the DCA during the removal of the drain caused recurrent hemorrhage from the DCA. Operators must perform complete hemostasis at the bleeding artery such as the DCA during the procedure of muscle dissection, and it is necessary to consider the location of drain placement and placement period based on each individual case. It has also been reported that connecting the drain to a suction system as quickly as possible during the operation reduces the occurrence rate of pSEH because coagulation of extravascular blood inadvertently causes pSEH.¹⁷ In our case, the drain was connected to the suction system before wound closure, and there were no problems in the drain's function.

Old age (≥ 60 years), preoperative nonsteroidal anti-inflammatory drug use, large intraoperative blood loss (≥ 1 L), intraoperative hemoglobin level ≤ 10 g/dl, Rh+ blood type, prothrombin time-international normalized ratio ≥ 2.0 , multilevel procedures, previous spinal surgery, and alcohol intake have been reported as risk factors for pSEH.¹⁻³ Old age and multilevel procedure were applicable to this case. There are also various reports regarding blood pressure

management during the perioperative period. Excluding Kao et al.'s¹⁸ study, most studies found that preoperative hypertension is not a risk factor for pSEH.^{1,2,19} However, an increased blood pressure of 50 mmHg or above during extubation is reported as a risk factor for pSEH.²⁰ Regarding postoperative care, a study reported the possibility that postoperative diastolic hypertension increases blood viscosity, causing blood clots and drain dysfunction, which in turn causes pSEH.¹⁸ In Ohba et al.'s⁷ study, postoperative diastolic hypertension was observed in all four cases of late-onset pSEH (48 or 72 h postoperatively). Although there were no problems in blood pressure management during extubation after the initial surgery in our case, systolic and diastolic blood pressures were abnormally high after the patient returned to the hospital room, which may be related to the occurrence of pSEH.

Conclusion

The DCA should be considered as a possible source of bleeding in pSEH. It is important to be aware of the DCA as a blood vessel because it requires careful attention when dissecting the semispinalis cervicis or performing operations for hemostasis before wound closure. We also found that the site of the drain and removal procedure may inadvertently cause pSEH. Although drainage methods should be modified according to each individual case, there are no clear indexes for the location of drainage placement, application of negative pressure, or duration of drain placement; hence, further investigation of these issues is necessary.

Conflicts of Interest Disclosure

All authors declare no conflicts of interest.

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