

Case Report



Emergent Vertebral Artery Embolization during C12 Screw Fixation for Rheumatoid Arthritis

Donghee Kim , Younkyu Jang , Kum Whang , Jongyeon Kim , and Sungmin Cho

Department of Neurosurgery, Yonsei University Wonju College of Medicine, Wonju Severance Christian Hospital, Wonju, Korea



Received: Sep 16, 2021
Revised: Sep 27, 2021
Accepted: Sep 28, 2021

Address for correspondence:
Sungmin Cho

Department of Neurosurgery, Wonju College of Medicine, Yonsei University, Wonju Severance Christian Hospital, 20 Ilsan-ro, Wonju, Korea.
E-mail: ns1287@hanmail.net

Copyright © 2021 Korean Neurotraumatology Society

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ORCID iDs

Donghee Kim
<https://orcid.org/0000-0001-5919-4506>
Younkyu Jang
<https://orcid.org/0000-0002-4434-5540>
Kum Whang
<https://orcid.org/0000-0002-3701-847X>
Jongyeon Kim
<https://orcid.org/0000-0002-9407-0127>
Sungmin Cho
<https://orcid.org/0000-0002-7593-4815>

Conflict of Interest

The authors have no financial conflicts of interest

ABSTRACT

The subaxial screw fixation technique is commonly used for fixation in a wide range of cervical diseases, including traumatic, degenerative, and neoplastic diseases, rheumatoid arthritis (RA), and spondyloarthropathy. Although it is regarded as a relatively safe procedure, several complications may be encountered during surgery, such as vertebral artery (VA) and nerve root injuries, facet violation, and mass fracture. We report a case of endovascular embolization after VA injury during a high cervical spinal surgery. A 48-year-old woman was scheduled for C-1-2-3 posterior fixation. Plain radiography of the cervical spine revealed a severely unstable state. During dissection around the C1 lateral mass on the right side, sudden brisk arterial bleeding was observed. On vertebral angiography, flow voiding was noted above the right V3 portion. After checking patent collateral flow from the contralateral VA, routine coil embolization was performed to pack the V3 segment. Iatrogenic vascular injuries due to spinal surgery are rare but serious complications. For patients with RA, we recommend careful preoperative evaluation before a high cervical surgical procedure to avoid iatrogenic VA injury and endovascular interventions that are safe and effective in the diagnosis and treatment of such vascular injuries.

Keywords: Vertebral artery; Rheumatoid Arthritis; Therapeutic Embolization

INTRODUCTION

Subaxial screw fixation technique is commonly used for fixation of wide range of cervical diseases including traumatic, degenerative, neoplastic, rheumatoid arthritis (RA), and spondyloarthropathy since introduced by Roy-Camille et al.^{2,7)} Regarded as relatively safe procedure, several complications may be encountered during operation, such as vertebral arteries and nerve roots injuries, facet violation, and mass fracture.⁶⁾ The incidence of vertebral artery (VA) injury during posterior C1-2 screw fixation is reported as approximately 3% and may remain asymptomatic or causing arteriovenous fistulae, occlusion, narrowing, or dissection, and lead to transient ischemic attacks, stroke, or death.¹⁶⁾ In our case, sudden massive bleeding in the operative field, emergent intraoperative embolization using multiple coils was done and good hemostasis was acquired. At the time of discharge, the patient showed no significant neurologic deficit or mental problem. We report a case of iatrogenic VA injury that was successfully treated using emergent coil embolization. Through this case, we want to discuss promising good strategies for iatrogenic VA injury.

CASE REPORT

A 48-year-old woman presented with right side pelvic pain and quadriparesis after slip down accident. The patient was planned for C1-2-3 posterior fixation previously. The X-ray findings showed pelvic bone fracture. In emergency room, in-hospital care by department of Orthopedic surgery was recommended. She had history of total knee replacement and total hip replacement 14 years ago and medical care for RA for 30 years. The plain x ray finding for cervical spine showed severe unstable state. The Ranawat index was 7.09 mm and the Redlund-Johnell index was 21.8 mm. The computed tomography findings revealed atlanto-dens interval and posterior atlanto-dens interval index were 70.5 mm and 10.97 mm respectively (**FIGURE 1**). For proper surgical management for upper cervical pathology, we decided to perform Subaxial fixation. During dissection around the C1 lateral mass, on the left side, sudden brisk arterial bleeding was encountered. Immediate packing with surgical was done and acceptable hemostasis achieved. Emergent intraoperative vertebral angiography was performed and flow occlusion was noted above left V3 portion by intra-op gauze packing compression (**FIGURE 2**). The flow of VA was confirmed only up to V3 segments, and no other extravasation was noticed in transfemoral cerebral angiography. After checking right posterior inferior cerebellar artery

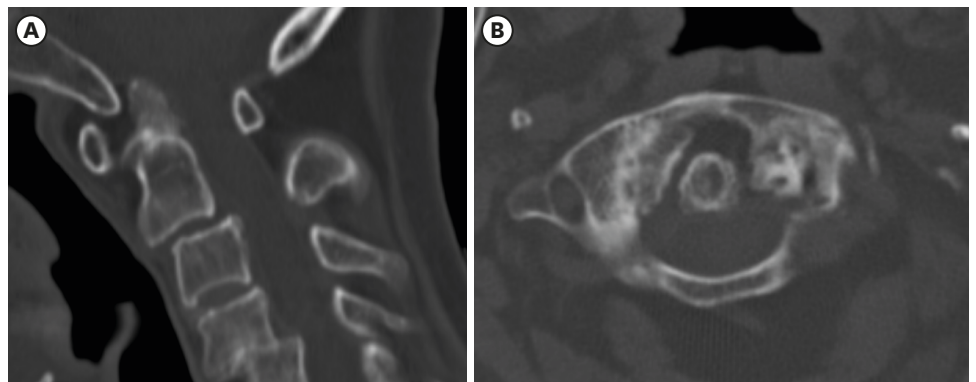


FIGURE 1. CT images. (A) sagittal view, (B) axial view. CT shows wide atlanto-dens interval and posterior atlanto-dens interval index.
CT: computed tomography.

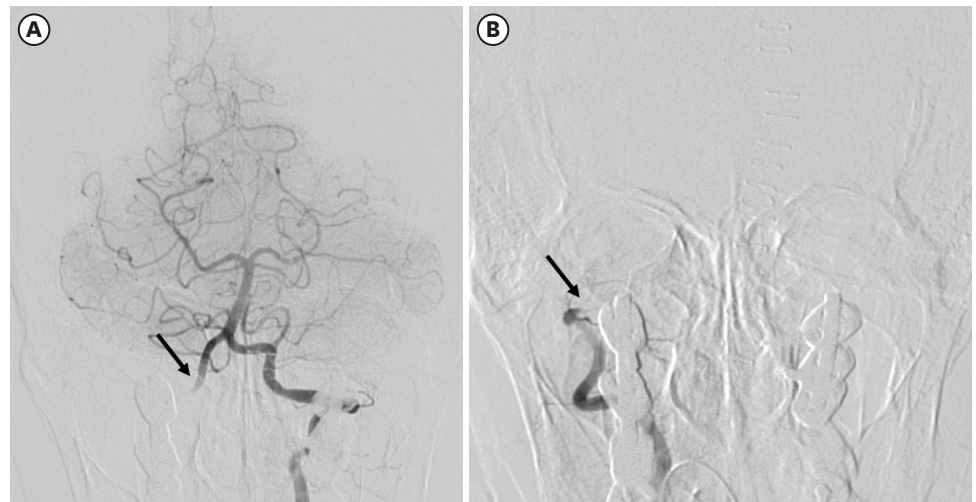


FIGURE 2. Pre-operative transfemoral cerebral angiography images, (A) left vertebral artery, (B) right vertebral artery. Left vertebral artery angiography shows right vertebral collateral (arrow) via basilar artery. Right vertebral artery angiography shows V4 segment occlusion (arrow) by op site packing.

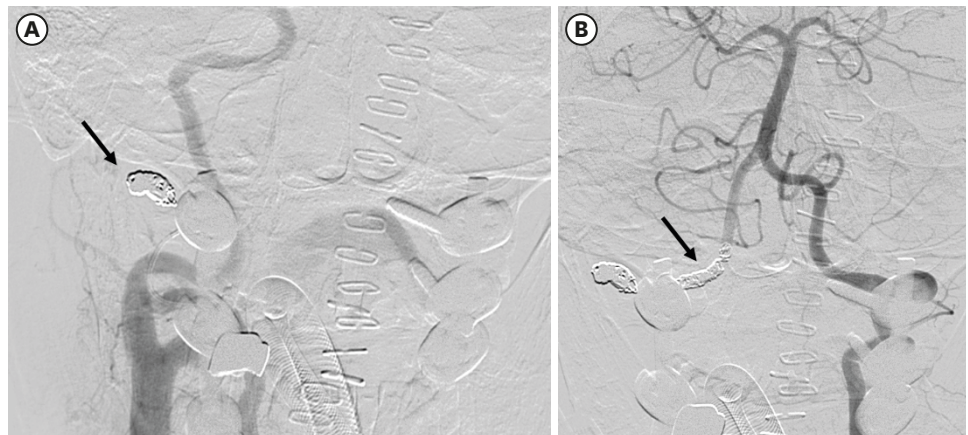


FIGURE 3. Post-operative transfemoral cerebral angiography images, (A) right vertebral angiography, (B) left vertebral angiography. Right vertebral angiography shows occlusion by coils (arrow). Left vertebral angiography shows right vertebral distal portion occlusion by coils (arrow).

and collateral flow from contralateral VA, we decided to trap the right VA. First. After guiding the microcatheter to the proximal of the suspected rupture point, coil packing was performed. Second, using the opposite VA, the microcatheter was moved to the right VA, and coil packing was performed on the distal area of the suspected rupture point. Total occlusion was noted from the involved area (**FIGURE 3**), It was confirmed that there was no bleeding after removal of the gauze packing on the surgical field of view. C1-2-3 screw fixation was done without further bleeding event. At discharge, the patient had no specific neurological symptoms other than pain at the surgical site, and the modified Rankin Scale was 0.

DISCUSSION

Iatrogenic vascular injuries after spine operation is uncommon though serious, life-threatening complications with high mortality and morbidity rates.⁵⁾ VA injury during posterior C1-2 transarticular screw fixation may remain asymptomatic or result in arteriovenous fistulae, occlusion, narrowing, or dissection. The incidence of VA injury during cervical spine surgery was reported as 0.3%–0.5% and most cases occur during corpectomy procedures.¹⁷⁾ The overall incidence of iatrogenic VA injury during cervical spine surgery in our country from 21 multicenter studies was reported as 0.08% and iatrogenic VA injury during C1-2 screw fixation occurred in 1.35% of the surgeries, which was the most common cause of this study.¹¹⁾ Three common causes of VA injury during cervical spine were analyzed by Smith et al.¹⁷⁾: 1) off of the midline use of a power burr, 2) excessive width of bone and disc removal, and 3) abnormal softening of the lateral bone resulting from a tumor or infection. Also, the presence of VA anomalies may increase the risk of injury. Gantwerker et al. presented a unique case unilateral VA injury during anterior cervical discectomy in a patient with bilateral VA anomalies. The authors concluded that careful preoperative evaluation of the course of the VA is critical to avoid iatrogenic VA injury.³⁾ Many authors recommend endovascular management, such as coil embolization, stent-assist coil embolization, and the use of stent grafts or covered stents for VA injury.^{1,5,8,10,12,15)} We report a case of iatrogenic VA injury case during C1-2-3 screw fixation, who has a long history of RA. The synovitis of RA injures structures in the cervical spine, allowing atlantoaxial subluxation, atlantoaxial impaction, and subaxial subluxation. Spinal cord and VA injury can ensue. Subluxations are common, but neurologic abnormalities are less so.¹³⁾ Miyata et al.¹⁴⁾ reported 3-dimension

analysis of the C2 pedicle screw trajectory in 2008. Their results strongly suggest that closer attention should be paid to the bone architecture of the axis in patients with RA. In C2 pedicle screw placement, the course of the VA through the axis can limit the space available for placement of the screw through the pedicle of the axis. It should be kept in mind that C-2 pedicle screw placement in patients with RA entails more risk than in patients without RA. Gillick et al.⁴⁾ reported that considering the course of the VA is important for the surgeon prior to C1-2 fusion. If the VA has an aberrant course, it may be unacceptably unsafe to place either C2 pedicle or C1-2 transarticular screws due to potential injury to the artery or violation of the foramen transversarium. C2 translaminar screws provide a safe alternative for fixation. In this patient, it is difficult to accurately determine because there is no preoperative angiography image, but it is presumed that the VA was damaged during dissection because the distance between C1 and the VA was closer than that of the general patient.

We recommend careful preoperative evaluation for RA patient before high cervical operation procedure for fear of iatrogenic VA injury. Since the VA is mostly on both sides, even if one side is sacrificed when the blood vessel is damaged, there may be no special neurological symptoms because of the collateral by the opposite vessel. Therefore, using it in case of iatrogenic VA injury can select a much more diverse rescue strategy. As with general dissection, the primary goal is to maintain parent artery patency, and if that is impossible, sacrifice would be a good option if it can save the posterior inferior cerebellar artery. Therefore, it should be recognized that a detailed examination of preoperative vertebral angiography can be of great help in such treatment. After this patient, we performed VA CT angiography as a routine for all cervical fracture patients

CONCLUSION

A detailed preoperative evaluation is necessary to prepare for various complications that may occur during high cervical spinal operation in RA patients. Also, for iatrogenic vascular injuries due to spinal surgeries are rare but serious complications that occurs during cervical fusion surgery, endovascular intervention that is safe and effective in the diagnosis and treatment immediately after the occurrence.

REFERENCES

1. Aydin E, Gok M, Esenkaya A, Cinar C, Oran I. Endovascular management of iatrogenic vascular injury in the craniocervical region. *Turk Neurosurg* 28:72-78, 2018
[PUBMED](#)
2. Ebraheim NA, An HS, Jackson WT, Brown JA. Internal fixation of the unstable cervical spine using posterior Roy-Camille plates: preliminary report. *J Orthop Trauma* 3:23-28, 1989
[PUBMED](#) | [CROSSREF](#)
3. Gantwerker BR, Baaj AA, Maughan PH, McDougall CG, White WL. Vertebral artery injury during cervical discectomy and fusion in a patient with bilateral anomalous arteries in the disc space: case report. *Neurosurgery* 67:E874-E875, 2010
[PUBMED](#) | [CROSSREF](#)
4. Gillick JL, Wainwright J, Das K. Rheumatoid arthritis and the cervical spine: a review on the role of surgery. *Int J Rheumatol* 2015:252456, 2015
[PUBMED](#) | [CROSSREF](#)
5. Gok M, Aydin E, Guneyli S, Akay A, Cinar C, Oran I. Iatrogenic vascular injuries due to spinal surgeries: endovascular perspective. *Turk Neurosurg* 28:469-473, 2018
[PUBMED](#)

6. Graham AW, Swank ML, Kinard RE, Lowery GL, Dials BE. Posterior cervical arthrodesis and stabilization with a lateral mass plate. Clinical and computed tomographic evaluation of lateral mass screw placement and associated complications. *Spine (Phila Pa 1976)* 21:323-328, 1996
[PUBMED](#) | [CROSSREF](#)
7. Inoue S, Moriyama T, Tachibana T, Okada F, Maruo K, Horinouchi Y, et al. Risk factors for intraoperative lateral mass fracture of lateral mass screw fixation in the subaxial cervical spine. *J Neurosurg Spine* 20:11-17, 2014
[PUBMED](#) | [CROSSREF](#)
8. Isaji T, Ohshima T, Miyachi S, Matsuo N, Kawaguchi R, Takayasu M. Treatment of ruptured vertebral artery dissection and abdominal hemorrhage associated with segmental arterial mediolysis using endovascular coil embolization. *World Neurosurg* 116:44-49, 2018
[PUBMED](#) | [CROSSREF](#)
9. Jang HJ, Oh SY, Shim YS, Yoon SH. Endovascular treatment of symptomatic high-flow vertebral arteriovenous fistula as a complication after c1 screw insertion. *J Korean Neurosurg Soc* 56:348-352, 2014
[PUBMED](#) | [CROSSREF](#)
10. Jung HJ, Kim DM, Kim SW, Lee SM. Emergent endovascular embolization for iatrogenic vertebral artery injury during cervical discectomy and fusion. *J Korean Neurosurg Soc* 50:520-522, 2011
[PUBMED](#) | [CROSSREF](#)
11. Lee CH, Hong JT, Kang DH, Kim KJ, Kim SW, Kim SW, et al. Epidemiology of iatrogenic vertebral artery injury in cervical spine surgery: 21 multicenter studies. *World Neurosurg* 126:e1050-e1054, 2019
[PUBMED](#) | [CROSSREF](#)
12. Lee SB, Rhim CH, Roh SW, Jeon SR, Rhim SC. Vertebral artery injury in c2-3 epidural schwannoma resection: a case report and literature review. *Korean J Neurotrauma* 13:39-44, 2017
[PUBMED](#) | [CROSSREF](#)
13. Lipson SJ. Rheumatoid arthritis of the cervical spine. *Clin Orthop Relat Res*(182):143-149 1984
[PUBMED](#)
14. Miyata M, Neo M, Ito H, Yoshida M, Fujibayashi S, Nakamura T. Rheumatoid arthritis as a risk factor for a narrow C-2 pedicle: 3D analysis of the C-2 pedicle screw trajectory. *J Neurosurg Spine* 9:17-21, 2008
[PUBMED](#) | [CROSSREF](#)
15. Ono I, Satow T, Ito Y, Hamano E, Matsubara H, Kataoka H, et al. Case of iatrogenic vertebro-vertebral arteriovenous fistula treated by combination of double-catheter and balloon anchoring techniques. *World Neurosurg* 128:98-101, 2019
[PUBMED](#) | [CROSSREF](#)
16. Prabhu VC, France JC, Voelker JL, Zoarski GH. Vertebral artery pseudoaneurysm complicating posterior C1-2 transarticular screw fixation: case report. *Surg Neurol* 55:29-33, 2001
[PUBMED](#) | [CROSSREF](#)
17. Smith MD, Emery SE, Dudley A, Murray KJ, Leventhal M. Vertebral artery injury during anterior decompression of the cervical spine. A retrospective review of ten patients. *J Bone Joint Surg Br* 75:410-415, 1993
[PUBMED](#) | [CROSSREF](#)