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Case Report

Acute Spinal Cord Compression after Surgical Management of Stab Wound Injury to the Vertebral Artery

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Abstract Stab wounds associated with spinal cord and vertebral artery injury (VAI) are not common. There is no established surgical approach and management. A case of spinal cord compression due to tamponade for hemostasis of VAI is reported in this article. An 18-year-old boy with a stab wound to the neck was provisionally treated at a provincial hospital. After the initial surgery, he had no neurological deficit. A second operation was done for hemostasis of VAI by muscle tamponade. After the second operation, there was sudden diminished sensation and dysfunction of the left leg and arm. Magnetic resonance imaging showed spinal cord edema from the occiput to C2, and spinal cord compression at C1-2 by a large epidural hematoma. C2 laminectomy for decompression was done in a third operation. We removed large amount of muscle tissue from the spinal cord and at the C1-2 left foramen. Sudden massive arterial bleeding was encountered from the left VA. Hemorrhage was successfully controlled by compressive packing with muscle. The clinical signs and symptoms of the patient were clearly improved post-decompression. While bleeding caused by VAI can be controlled by hemostatic packing, there remains a risk of delayed hemorrhage from pseudoaneurysm formation.

Keywords: Vertebral artery injury, Acute spinal cord compression, Stab wound

Introduction

Spinal cord damage due to stab or gunshot wound injury is rare, occurring in 1.5% of cases, with unclear surgical management strategy.[1,2] The incidence of vertebral artery injury (VAI) in cervical spinal injury is 1% for gunshot wounds and 7.4% for stab wounds.[3] VAI commonly results in serious life-threatening conditions for patients, such as severe hemorrhage, cerebellar or brain stem infarction, or even death. In this article, we report a case of acute spinal cord compression after surgical management of a stab wound to the neck causing VAI.

Casereport

An 18-year-old male patient presented with a sharp penetrating neck trauma on the left side, at a provincial hospital. He underwent provisional surgery to control the bleeding by using gauze compression and was transferred to our hospital 6 hours later. On examination, he was awake and pale with a sutured 5-cm wound at the left angle of the mandible (Zone II of the neck). The left carotid artery was clearly palpable, and no clinical neurological abnormalities could be detected. Doppler ultrasound showed no abnormalities of the carotid

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blood vessels, but there was extensive edema of the subcutaneous tissues at the lower face and neck. The patient underwent a second-look operation, performed by vascular surgeons.

An incision along the previous incision on the left side was made. After revealing the blood vessels, we found the cut deep to the intervertebral foramen. While removing the gauze compression, we found the left vertebral artery to be completely transected causing considerable hemorrhage, as well as a 2-cm sharp cut wound to the left internal carotid artery. We mobilized parts of the sternocleidomastoid muscle to the area of the vertebral artery to help stop the bleeding. We then suture-repaired the internal carotid artery and closed the skin incision. The patient was transferred to ICU.

After 8 hours in the ICU, the patient developed left hemiparesis, with grade 0/5 muscle strength at the left arm and leg, as well as decreased left-sided sensation from the C3 level. There was no abnormal finding on CT scan of the brain and cervical spine. Doppler ultrasound of the left neck showed reduced left internal carotid artery flow rate and normal left vertebral artery. Spinal MRI revealed cervical spinal cord edema and a 28 x 20 mm mass compressing the spinal cord at the C1-2 level. A diagnosis of spinal cord compression at C1-2 by an epidural hematoma was made (**Figure 1**). The patient underwent a third operation one day later.

C2 laminectomy for decompression was done with the patient in the prone position. During the surgery, much muscle tissue was removed from the spinal cord and the left foramen at the C1-2 level (**Figure 2**).

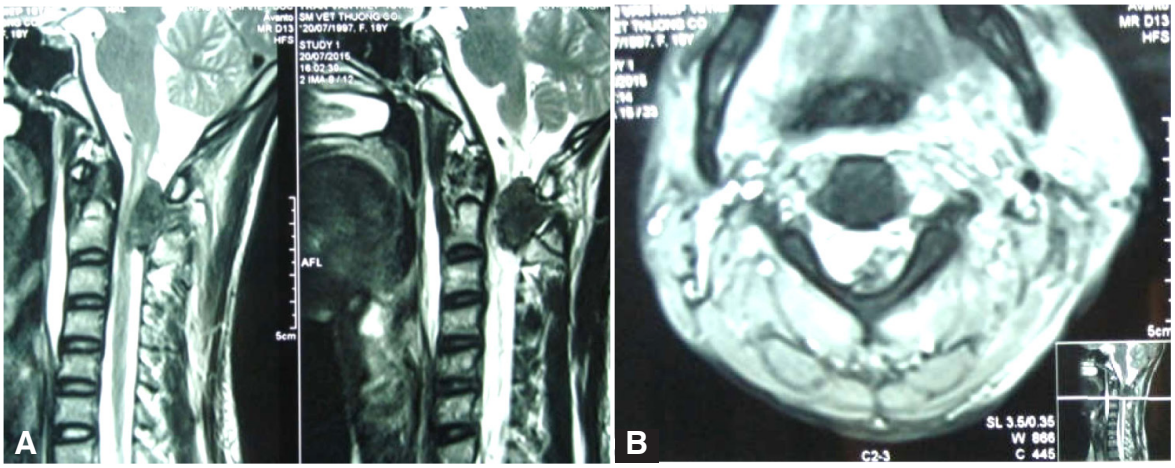

Figure 1 The second postoperative spinal MRI.
1A: Sagittal plane; revealing cervical spinal edema, and a mass lesion compressing the spinal cord at C1-C2.
1B: Axial plane; showing the same mass lesion.

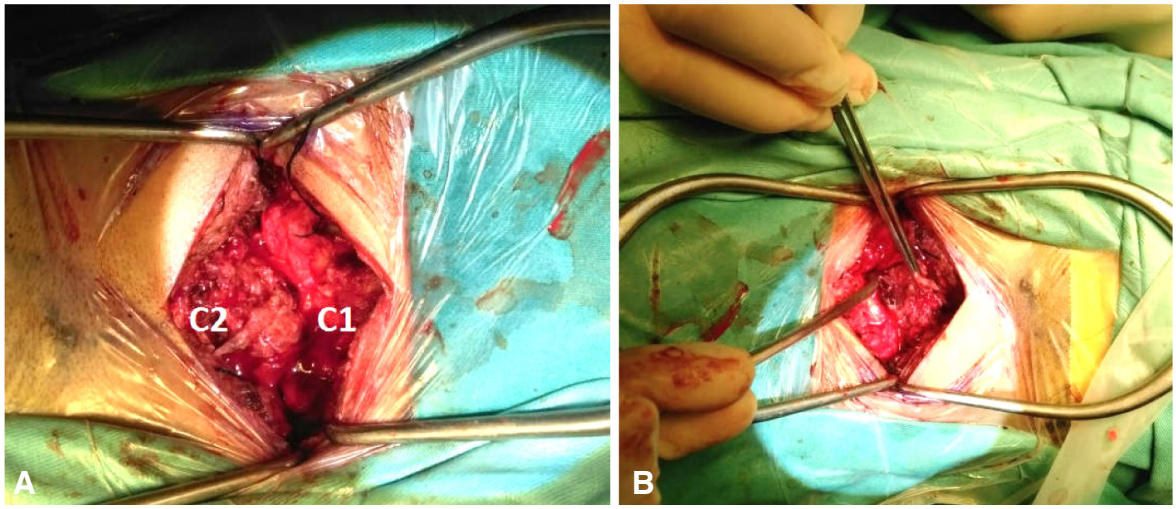

Figure 2 2A: Muscle tissue causing C1-2 spinal cord compression; 2B: Removing muscle tissue from the left C1-2 transforaminal space.

A 1.5 x 1cm epidural tear was found in the C1-2 area on the left, with spinal fluid leakage and an epidural hematoma. During the removal of muscle tissue, an abrupt massive arterial bleeding was encountered from the complete cut in the left veterbral artery. After failed hemostatisc attempts, we decided to use the erector spinae muscle combined with hemostatic sponge to compress into the C1-2 foramen. After the bleeding was stopped, the dural tear was repaired with an artificial membrane, and the incision was closed.

On the second post-operative day, clinical signs and symptoms of the patient clearly improved. He was completely awake, the muscle strength of his left arm and left leg was 2/5 and 3/5 respectively. After 2 months of rehabilitation, all surgical incisions have healed (**Figure 3**), there was no spinal fluid leakage, and the muscle strength of his left arm and left leg was 3/5, along with improved sensation. Postoperative MRI showed spinal cord edema at C2, complete absence of compressing muscle, with minor intramuscular hematoma (**Figure 4**).

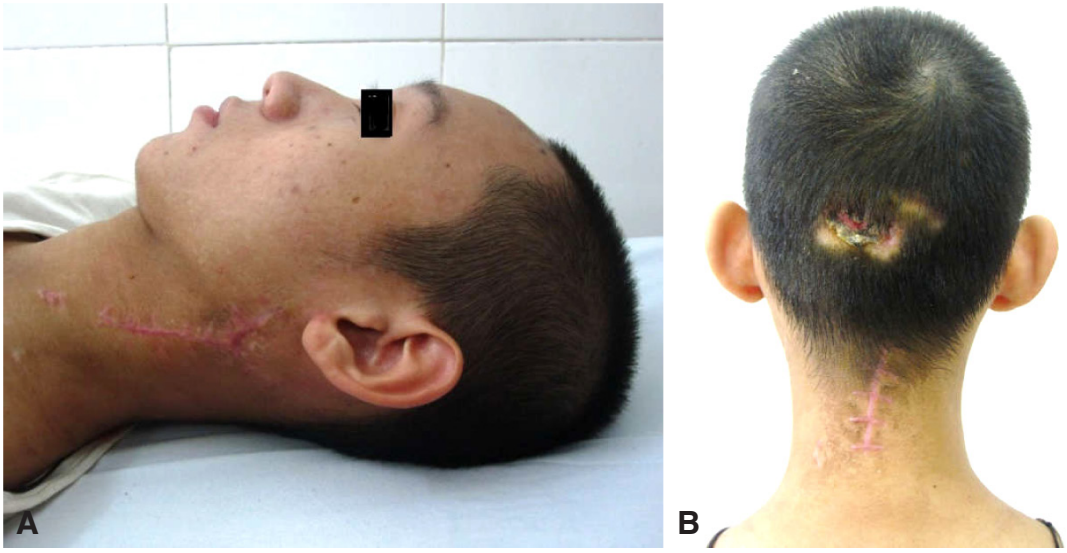

Figure 3 Surgical scars at 2 months, showing.
3A: Wound at the left neck
3B: The healed posterior incision.

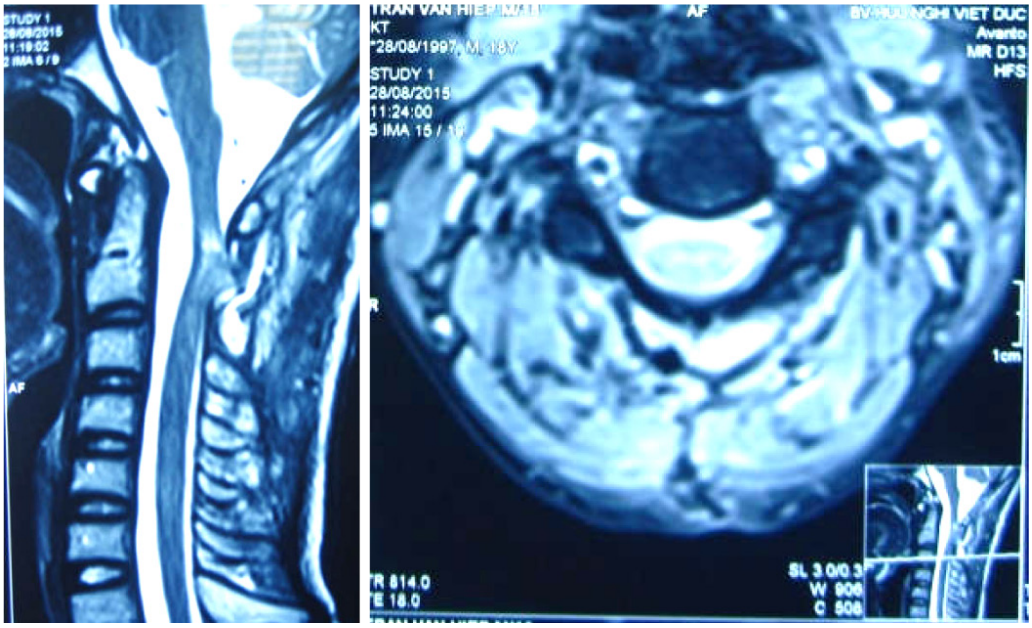

Figure 4 Postoperative MRI revealing cervical cord edema at the C2 level, with the tamponade muscle completely removed. There was hematoma in the muscular region

Discussion

In the literature, a common cause of VAI is cervical trauma. Injurious mechanisms causing cervical dislocation or spinal fractures can damage not only the spinal cord but also the vertebral artery. In contrast, in surgical trauma, such as in anterior cervical discectomy, VAI is a rare complication with an incidence of 0.5%.[7] High risk procedures include invasive incisions too anterior to one side, in Luschka's joint or foramen decompression; the removal of lateral disc herniation; posterior spondylotomy; spinal fusion surgery; or those with confusing anatomical landmarks. The consequence of VAI is usually uncontrolled severe hemorrhage.

In cervical spinal surgery, hemorrhage during operation is of two types: injury due to the pedicle screw and that due to direct surgical trauma. In VAI due to pedicle screws, the bleeding is usually not too severe and can be controlled using the bone wax or screw tightening. In contrast, VAI due to direct trauma often causes severe bleeding difficult to control. Although temporary hemostasis can be achieved by blind compression with gauze or muscle tissue, bleeding could resume once the compressive agent is removed. Other approaches such as artery ligation, or interventional radiological approaches to embolize the vertebral artery, will often require time to prepare the patient, to finding adequate equipment, and consultation or coordination with vascular surgeons and radiologists, all of which are very difficult to do or obtain under emergency conditions.

In the present case, the acute cord compression was at the C1-2 level, corresponding to the level of the second surgery. We assumed this to be due to an epidural hematoma, and chose the posterior approach, opening the C2 lamina to remove the blood clot. Unexpectedly, the compressive agent was muscle. Apparently, in the second operation, the vascular surgeon had displaced and inserted a part of the sternocleidomastoid muscle to help stop the bleeding. This muscle mass followed the interlaminar space, going from front to back, into the spinal canal, causing severe spinal cord compression. To he best of our knowledge, the present report is the first of this rare event.

The removal of the muscle mass at the surgical area (left C1-2 interlaminar space) accidentally removed the compressive agent, causing severe re-bleeding. However, after re-compressing the vertebral artery by using part of the erector spinae muscle mixed with hemostatic sponges, the bleeding was once again controlled. This is a validation of a method of vertebral artery hemostasis using crushed muscle tufts mixed with hemostatic materials.

It was important that we evaluate the adequacy of the blood supply from the opposite vertebral artery. For our patient, the left vertebral artery was completely cut off. Fortunately, after all three operations, the patient remained fully concious. We might conclude that there was adequate collateral blood supply from the right vertebral artery to all areas of the brain. Had the patient been more stable with sufficient time for more thorough investigation, we might have performed angiography to evaluate the opposite vertebral artery. This might have allowed us to do non-invasive embolization of the injured vertebral artery.

According to one study[1], the prevalence of left vertebral artery hypoplasia was 5.7% and total absence was 1.8%. The prevalence of right vertebral artery hypoplasia was 8.8% and completely absence, 3.1%. Ligating either vertebral artery would be associated with a mortality up to 12%.[6] In the present case, a vascular doppler ultrasound performed after the first two operations erroneously found the left vertebral artery to be intact. This suggests that in the presence of edematous tissues and wound dressings, vascular doppler ultrasound can sometimes be misleading. Thus, there is need for CT angiography for accurate diagnosis of vascular injury.

A disadvantage of C2 laminectomy is postoperative spinal instability. Due to the emergent nature of the operation, as well as the excessive bleeing, it was difficult, and possibly unsafe, to control and fix to the upper cervical pedicle by screws. Therefore, we decided not to fix the spine and to quickly terminate the operation to ensure the patient's safety. The patient might undergo cervical spinal fixation in the near future, when the overall condition of the patient is stable and functional rehabilitation is good.

In 2006, Jeong-Wook Choi[2] reported two patients who were treated for vertebral artery injury by insertion of hemostatic material. Four to 10 days after the procedure, these 2 patients presented with vertebral aneurysms of the injured vessels, with enlarging neck masses and dyspnea. Both patients were successfully treated with vertebral artery embolization without leaving any neurological sequelae. Therefore, it is important to recognize the possibility of aneurysms occurring at the site of injury after compressive hemostasis.

Conclusion

Spinal cord and vertebral artery injury caused by stab wounds to the neck are rare. Compressive packing with anterior muscles in VAI may cause spinal cord compression because the muscle mass can enter the cervical foramen into the spinal canal. Muscle compression combined with hemostatic material can be effective in arresting hemorrhage from injured verterbral artery. However, it is necessary to be wary of and recognize aneurysms at the site of vascular injury.

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