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Case Report

Abnormal Terminal Vertebral Artery in Atlantoaxial Dislocation: A Rare Case Report

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Abstract:

Atlantoaxial dislocation (AAD), is a challenging disorder of the craniocervical junction. Because of its deep location and intricate anatomic structure, the craniocervical junction is always a difficult region for spine surgery. (1) Risk of vertebral artery injury makes the surgery difficult. Patient having an abnormal vertebral artery, like our patient, makes the situation more complicated.

Key words: Vertebral artery anomaly, AAD, Atlantoaxial dislocation, Posterior fixation of C1-C2

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Introduction

Atlantoaxial dislocation (AAD) is a less common problem. It arises following trauma, tumors or congenital abnormalities in the upper cervical region. It is a challenging disorder of the cranio-cervical junction. AAD can cause compression of the spinal cord or medulla, resulting in limb numbness and weakness, sphincter dysfunction, disordered circulation and respiration center dysfunction. The mortality of trauma-related AAD is reportedly 60%–80%; serious injuries in this region can lead to paralysis and death.[1]

The vertebral artery (VA) courses laterally after exiting the axis (C2) transverse foramen. However, the course may be anomalous at times, especially in patients with craniovertebral junction anomalies. In these case the artery may traverse the atlas (C1)-C2 joint posteriorly and inferiorly to the C1 arch. Such an anomalous course poses a surgical challenge while performing direct posterior reduction and manipulation. The detailed description of such an anomalous course and intraoperative safeguarding of the VA has been described.[2]

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The surgery for congenital cranio-vertebral junction (CVJ) anomalies has shifted from the less stable sub-laminar wiring to the more rigid lateral mass fusion. However, these approaches have a greater risk of injuring the vertebral artery (VA). Besides, the probable presence of an anomalous artery in patients with congenital CVJ disorders increases the risk of jeopardizing it intraoperatively.[3]

The recent literature lays emphasis on the preoperative diagnosis of such anomalous vessels in patients with CVJ disorders. However, little is mentioned about the operative techniques to prevent injury to such vessels.[3,4]

Such injuries can occasionally give rise to significant neurological deficits, depending on the amount of area it supplies and collateral flow, or they may lead to erosion of the vessel.(3)

Case report

A lady of 45 years' age, presented with history of neck pain and progressive weakness of all four limbs. Later on she was unable to walk at all and become bedbound. All four extremities show long tract signs. Plain x-ray of cervical region showed partially reducible atlantoaxial dislocation (AAD) with partial fusion of atlas with occipital bone and straightening of cervical lordosis. Magnetic resonance imaging showed severe compression of spinal cord at the cervico-medullary junction. Computed tomography (CT) of the cranio-vertebral junction (CVJ) showed antero-posterior dislocation of C1-C2 and absence of C1 transverse foramina on left side. On CT angiogram, both vertebral artery was well visualized but left vertebral artery showed anomalous course which passes beneath the C1 arch instead of passing above the C1 posterior arch and crossed the C1-2 joint posteriorly (Fig. 1).

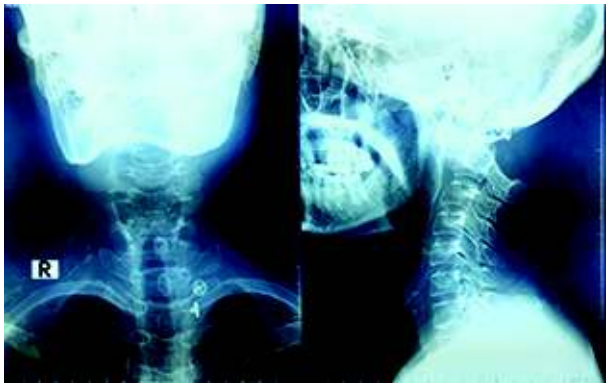

Fig.-1: *X ray cervical spine showing occipitalized C*

The right VA was normal in diameter and course. The craniovertebral junction was approached via posterior approach. Left sided C2 nerve root was sectioned. Subperiosteal dissection was carried out and left VA was mobilized and safeguarded during drilling, screw insertion and manipulation of the joint. On the right side screw was inserted in usual fashion. C1-C2 fixed with screws (C1 lateral mass and C2 pedicle) and rods. Postoperative recovery was uneventful. Patient started walking without assistance 02 weeks post op. Plain X-ray showed satisfactory reduction (Fig 5).

Fig.-2: *MRI of CVJ sagittal section showing severe compression of spinal cord*

(a) (b)

Fig.-3: *(a) CT Scan of CVJ sagittal view, (b) CT scan of CVJ coronal view*

Fig.-4: *CT angiogram of vertebral artery: Left V3 segment is below the C1 posterior arch*

Fig.-5: *Postoperative X ray*

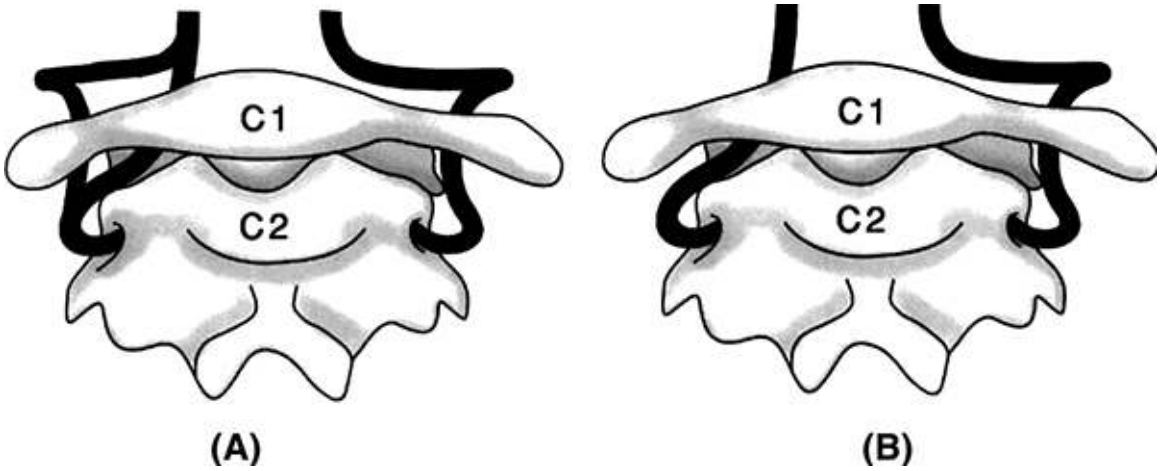

Figure showing Two representative VA anomalies at the CVJ. (A) Fenestration. (B) Persistent first intersegmental artery. VA indicates vertebral artery; CVJ, craniovertebral junction (Copyright Yamazaki et al)[4]

Discussion:

The VA traverses through the transverse foramina of C6 to C1. After exiting the C3 transverse foramen, the artery courses beneath the pars interarticularis of C2 and then passes through the C2 transverse foramen. After exiting from the C2 transverse foramen, normally vertebral artery courses posterolaterally and cranially to enter the foramen transversarium of C1, forming a short proximal loop. Then vertebral artery courses obliquely on the superior surface of C1 posterior arch forming the distal loop before penetrating the posterior atlanto-axial membrane and dura. [2, 5-8)]

Portion of the VA from the C2 transverse foramen to entry into the dura is the V3 segment. Numerous anomalies of the V3 segment have been described.[2,8]

Studies have shown anomalies of the VA at the extra- and intraosseous regions of the CVJ. There are 2 representative anomalies of the extraosseous course of the VA: fenestration and persistent first intersegmental artery (Figure A, B). In the former, the VA is duplicated after emerging from the C2 transverse foramen; one branch enters the spinal canal between C1 and C2 and the other courses normally, passing through the C1 transverse foramen and entering the spinal canal at the cranial side of the C1 posterior arch (Figure A). In the latter, the VA enters the spinal canal at the caudal portion of the C1 posterior arch after emerging from the C2 transverse foramen, without passing through the C1 transverse foramen (Figure B).[4]

This extraosseous course, if anomalous, is vulnerable to injury during posterior C1- C2 dissection and manipulation. Alternatively, the occipitocervical fusion can be performed in these patients. However, such fusion hampers the neck mobility significantly and has its own limitations.[9]

The risk of injury to the vertebral artery (VA) as a complication of surgery has become a major problem. A large-scale investigation of 1318 patients who underwent surgery for C1–C2 transarticular screw (TAS) fixation showed that VA injury occurred in 4.1% of patients and some of them developed cerebellar infarction or brain stem infarction. Thus, the importance of preoperative evaluation of the VA course has been emphasized.[4]

In our patient, CT angiogram reveals the V3 segment of left vertebral artery passes beneath the C1 arch (i.e. persistent first intersegmental artery type) and posterior to C1-C2 joint which is the site of screw insertion. The right vertebral artery was normal in location. Both vertebral artery was similar in diameter, which is similar to a anatomical case report published by F-Z Jian et al.[10] Without careful evaluation the artery is in high risk to get injured during C1-C2 transarticular or pars pedicle screw insertion.

Neo et al retrospectively analyzed a case in which massive arterial bleeding occurred at the insertion of a C1 lateral mass screw. They concluded that a persistent first intersegmental artery was overlooked before surgery and therefore intraoperative bleeding occurred because of unintentional injury to the anomalous VA. Therefore, the extraosseous course of VA should be carefully evaluated for anomalies before performing instrumentation surgery at the CVJ. [11] 3D CTA is a useful tool for this evaluation, as it can depict the reciprocal anatomy of complicated VA courses and the surrounding osseous tissue.[4]

Conclusion:

This case report emphasizes on the need for preoperative assessment of vertebral artery course in preparation for CVJ surgery to avoid intraoperative catastrophe. The dominance of the vertebral artery will also be kept in mind in deciding the surgical option.

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