Vertebral Artery Agenesis in AAD and Basilar Invasination: A Case Report

Manash Bora, Radhey Shyam Mittal

Department of Neurosurgery, SMS Medical College, Jaipur, India

ABSTRACT

Anomalous or hypoplastic vertebral artery is reported in literature as incidental or in patients presenting with features of posterior fossa TIA, stroke. Unilateral agenesis of vertebral artery and its association with AAD is rare. We report a case of multiple CV junction anomalies with right vertebral artery agenesis. The case was examined clinically, investigated with MRI and Dynamic CT of CV Junction, CT Angiogram of Vertebral Artery and was operated. Preoperative knowledge of this anomaly helps in surgical planning.

KEY WORDS: Agenesis, atlantoaxial dislocation (AAD), basilar invasination (BI), vertebral artery (VA)

INTRODUCTION

Craniovertebral junction anomalies are common entities in neurosurgical wards. These anomalies require various neurosurgical procedures including fixations. Vertebral artery, the first branch of subclavian artery is known for various anomalies, among them agenesis is rare (7, 8). The knowledge of vertebral artery anatomy is important in craniovertebral junction anomalies for various neurosurgical procedures. We report a case of unilateral agenesis of vertebral artery in a case of Atlantoaxial dislocation (AAD) with Basilar invasination (BI) with incomplete posterior arch of atlas on the same side and bilateral posterior inferior cerebellar arteries (PICA) originating from basilar artery.

CASE

A 35 year old male presenting with asymmetric spastic weakness of all four limbs amounting to difficulty in walking for one year. Patient also complained of numbness in all four limbs for last ten months. There was no history suggestive of any medical illness.

On examination patient had cervical myelopathy in the form of increased tone, 4/5 power at all joints according to MRC power scale, 3+ deep tendon reflexes in all four limbs, bilateral extensor planter with asymmetric partial loss of sensations below C4 dermatome involving all modalities.

On MRI cervical spine and Craniovertebral (CV) junction there was compression of cord at cervicomedullary junction with basilar invasination (Figure 1).

Dynamic CT CV junction showed AAD with BI is seen (Figure 2A, B). Effective canal diameter at the level of C1 was only 9 mm indicating severe canal narrowing. Posterior arch of C1 was absent on right side (Figure 5).

On CT angiogram of neck vessels right vertebral artery (VA) was absent (Figure 4A-C). On left side vertebral artery was normal and continues as basilar artery (BA). PICA originated from BA on either side (Figure 6).

Transoral odontoidectomy followed by foramen magnum decompression and occipito-cervical screw and rod fixation done using combined anterior and posterior approach (Figure 3). Postoperative period was uneventful and patient was discharged on 5th post-op day. At the time of discharge patient had subjective relief of spasticity and numbness.

DISCUSSION

Vertebral artery is divided into four segments; V1: from origin to foramen transversarium of C6 vertebra, V2: Ascends vertically in foramen transversarium of C6 to C2 vertebrae,
V3: exits from C2 foramen curves posterolaterally and then medially to enter the vertebral canal, V4: intradural, pierces the dura and joins the opposite VA to form Basilar artery in the subarachnoid space (4).

V3 segment is further subdivided into the vertical part V3v* passing vertically upwards, crossing the C2 root and entering the foramen transversarium of C1, and the horizontal part V3h*, curving medially and posteriorly behind the superior articular process of the atlas, V3o* the oblique portion before entering the dura (4).

Figure 1: MRI CV junction.

Figure 2: Dynamic CT CV junction.

Figure 3: Post-operative CT.
Vertebral Artery Agenesis in AAD and Basilar Invasination: A Case Report

Figure 4: A) CT Angiogram Vertebral artery, B) CT Angiogram Vertebral artery, C) CT Angiogram Vertebral artery.

Figure 5: Absent Post Arch of C1.

Figure 6: PICA arising from Basilar artery.

Development of vertebral artery

To understand the embryology of vertebral artery brief overview of development of aortic arch and great vessels are important. On 2nd gestational week, primitive aortae are continuous with two endocardial heart tubes (Figure 7A). Two ventral aortae fuse to form aortic sac (Figure 7B). On 3rd to 4th gestational week pharyngeal arches appear with...
their arteries arise from aortic sac (Figure 8). On further
development several changes take place in arterial arches
to produce adult pattern. Major portion of 1st, 2nd & 5th
arches disappear and 3rd, 4th arches open into ventral
& 6th arch opens into dorsal part of aortic sac. Cervical
intersegmental arteries arise from dorsal aorta. The proximal
part of right subclavian artery is derived from right 4th arch
artery & distal part from right 7th cervical intersegmental
artery which arise opposite 4th arch artery. On left side the
subclavian artery is derived entirely from left 7th cervical
intersegmental artery (2,3,5).

The first part of vertebral artery i.e. V1 develops from
dorsal division of seventh cervical intersegmental artery; V2
develops from post-costal anastomosis between first to sixth
cervical intersegmental arteries; V3 develops mainly from
spinal branch of first cervical intersegmental artery & partly
from proatlantal artery of Padget (ProA); and V4 develops
from proatlantal artery of Padget (3) (Figure 9,10).

Proatlantal artery of Padget (ProA) has a typical
segmental configuration; with a dorsospinal division that
sends a radicular branch along the first cervical nerve root
(C1). At the adult stage, this radicular artery of C1 becomes
the terminal segment of the VA. It divides into anterior and
posterior radicular branches just before entering its intradural
course. The anterior radicular branch turns, therefore, into
the intradural component of the VA (V4 segment) plus a
short extradural segment (distal V3 segment). Distally, it
divides into ascending and descending rami that fuse along
the midline with their contralateral counterparts to form the
BA and the anterior spinal axis, respectively. The descending
ramus of the posterior radicular branch of C1 becomes the
ipsilateral cranial origin of the posterior spinal artery (2,5).

Anomalous origin of the vertebral arteries is not very
common. In fact, most types have been published in case
reports (4). Anomalous or hypoplastic vertebral artery is
reported in literature as an incidental finding or in patients

Figure 7: A) Primitive aorta,
B) Primitive aorta.

Figure 8: Arch Arteries.
Vertebral Artery Agenesis in AAD and Basilar Invasination: A Case Report

Figure 9: Vertebral artery development.

Figure 10: Vertebral artery development.
presenting with features of posterior fossa TIA, stroke, myelopathy due to cord compression by aberrant VA (1) and rarely in patients with tinnitus and migraine (6).

Xingwen WANG studied anatomical variation of vertebral artery (VA) at the craniocervical junction (CVJ) in patients with occipitalization of the atlas in 48 patients (7). The scientist studied total 96 vertebral arteries & described 5 types of VA anomalies in relation to occipitalization of the atlas. Type 1: the VA is single trunk, running between the occipitalized atlantal posterior arch and axial plate (19.79%); Type 2: single trunk VA runs through a bony canal between the assimilated atlas and occipital cranium (44.79%); Type 3: single trunk VA runs between the normal occipital cranium and atlantal posterior arch (30.21%); Type 4: VA has a fenestration, with one branch running below the occipitalized atlantal posterior arch and the other branch running above the atlantal posterior arch (3.13%), 2 branches merge as one VA trunk after entering into the dura; Type 5: hypogenesis or agenesis of VA (2.08%). In our case VA is of Type 5 which is the least common variety mentioned by the author.

Yamazaki M and colleagues looked for anomalous VA in 100 consecutive patients who underwent CVJ instrumentation surgery (8). Abnormal courses of the VA were detected in 10 out of 100 cases: 2 had fenestration and 8 had a persistent first intersegmental artery. There was no case of vertebral artery agenesis.

**CONCLUSION**

Agenesis of unilateral VA in association with AAD, BI & unilateral atrophy of posterior hemiarch of C1 is very rare. Preoperative knowledge of this anomaly helps in surgical planning and avoids potential and serious complications.

**REFERENCES**


Manuscript submitted September 25, 2014. Accepted October 13, 2014. **Address correspondence to:** Manash Bora, SMS Medical College, Neurosurgery, Jaipur, India Phone: +91 141 251 83 41 email: versatile11ghy@gmail.com