Acta Neurochirurgica (2018) 160:1621–1623
https://doi.org/10.1007/s00701-018-3601-1

CASE REPORT - PEDIATRIC SPINE

Bilateral persistent 'second' intersegmental vertebral arteries: illustrated with a case

Madhivanan Karthigeyan[1] · Pravin Salunke[1] · Mandeep Singh Kataria[1]

Received: 23 May 2018 / Accepted: 14 June 2018 / Published online: 23 June 2018

Abstract

Congenital craniovertebral junction deformities can be associated with an anomalous vertebral artery (VA). At times, the artery crosses the joint posteriorly (i.e., persistent first intersegmental artery) and is at risk during posterior approach. We report a new variant, wherein the bilateral VA coursed medially after exiting the C3 transverse foramina to lie beneath C2 pars interarticularis and enter the foramen magnum (without passing through C2 transverse foramen anywhere along its course). This is possibly a result of bilateral persistent second intersegmental arteries. It is pertinent to recognize this unusual variant to avoid VA injury, especially while inserting C2 pars/transarticular screw.

Keywords Anomalous vertebral artery · Persistent first intersegmental artery · Posterior C2–3 fusion · Pars interarticularis · Congenital atlantoaxial dislocation

Introduction

The feasibility to perform posterior C1–C2 fusion in the presence of an anomalous vertebral artery (VA) has been well documented [3, 4, 7]. The VA can be safely dissected from the surrounding structures and is not a deterrent for the desirable facetal drilling, joint manipulation, and screw placement [3, 4]. The anomalous VA can take different forms, the most common being a persistent first intersegmental artery [3]. Other variants include fenestrated type, inverted variant, and origin of PICA from V3 segment [3, 4, 7]. In this report, we introduce yet another new variant namely bilateral persistent second intersegmental artery in a patient with congenital atlantoaxial dislocation (AAD).

Case report

A 12-year-old girl presented with insidious onset neck pain and mild stiffness of limbs for 5 years duration. Plain lateral view radiography and computed tomography of craniovertebral junction showed atlantoaxial dislocation (atlantodental interval 8 mm). Additional findings were absent C1 posterior arch, C2–3 fused vertebrae and block vertebrae extending from C5–C7 (Fig. 1). The bilateral C2 transverse foramina were atretic. CT angiography (CTA) showed that the bilateral vertebral arteries after exiting the C3 transverse foramen on both sides passed beneath the pars instead of a normal course through C2 transverse foramen (Fig. 2). Magnetic resonance imaging revealed compression at cervicomedullary junction. She underwent C1–C2 posterior fusion using C1 lateral mass and C2 pedicle screws. The screw positions were confirmed using intraoperative CT along with reconstructed images. The joint space was drilled, spacers inserted, and manipulated to achieve realignment in all planes. Postoperatively, her symptoms had improved. CT showed satisfactory reduction of AAD.

Discussion

In patients with congenital AAD, the trend in management has shifted from the earlier used occipitocervical fusion to the currently preferred short segment posterior C1–C2 fusion [2, 5, 6, 8]. This requires remodeling of C1–C2 joints along with their manipulation to achieve multiplanar realignment. Apart from the congenital osseous anomalies of C1–C2, an important structure that determines the feasibility of this

This article is part of the Topical Collection on *Pediatric Spine*

✉ Madhivanan Karthigeyan
karthigeyanm82@gmail.com

[1] Department of Neurosurgery, Postgraduate Institute of Medical Education and Research (PGIMER), Sector 12, Chandigarh 160012, India

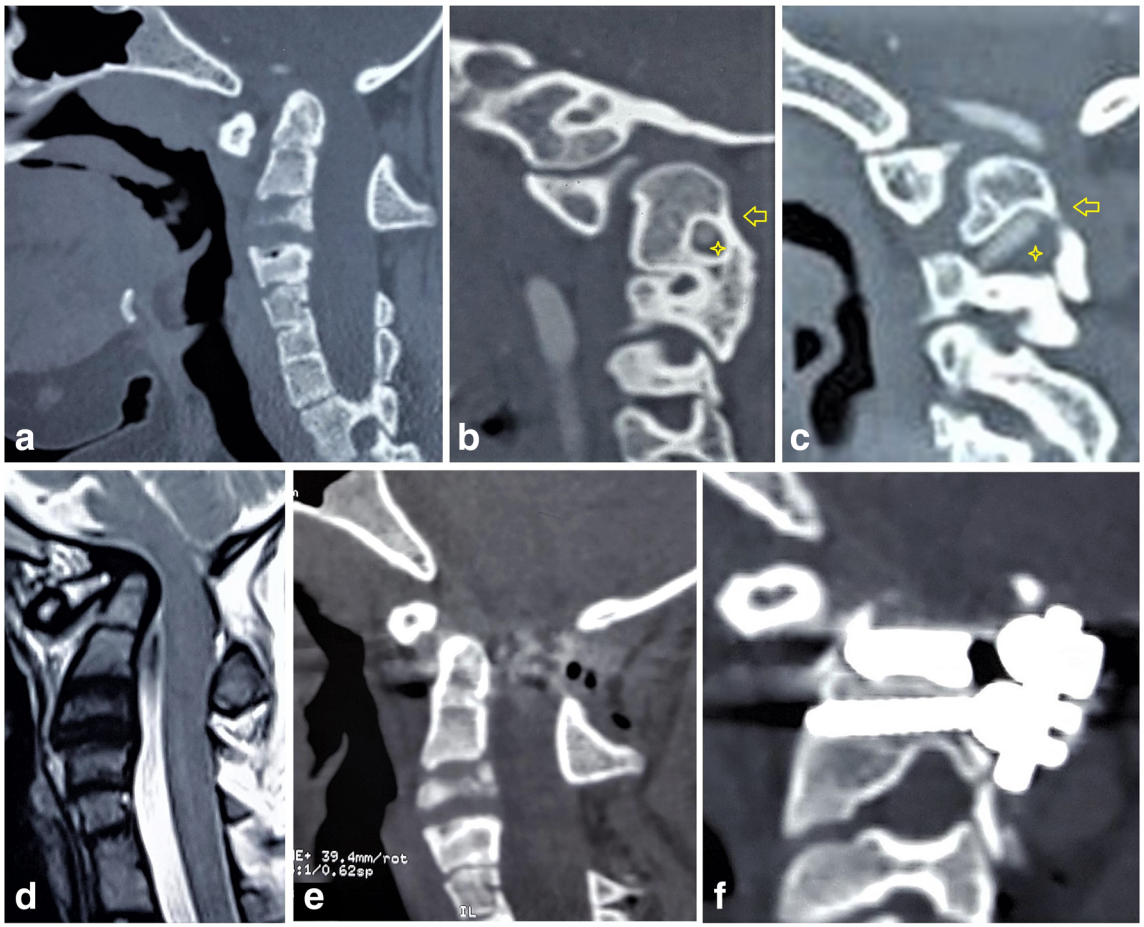

Fig. 1 **a** Preoperative midsagittal (**a**) section of computed tomography (CT) shows atlantoaxial dislocation (AAD) along with C2–3 fusion and subaxial block vertebrae. Parasagittal CT (**b** and **c**) shows vertebral artery (asterisk) lying close to inferior wall of pars (arrow). **d** Magnetic resonance imaging (sagittal view) demonstrates compression at cervicomedullary junction. **e** Postoperative midsagittal CT image shows satisfactory reduction of AAD. **f** Parasagittal cut show placement of C2 pedicle screw with intact inferior wall

procedure is the course of the VA that runs in close relation to it. Their anomaly is not uncommon [3, 4, 7]. In such cases, a preoperative CT angiography is of utmost importance to characterize and study the course of VA especially with respect to its V3 segment [3]. The VA can cross the joints posteriorly as in the case of a persistent first intersegmental variant which requires release from the posteriorly placed C2 ganglion. This and the other variants are seen after the artery exits the C2 transverse foramen [3]. However, in the described case, the artery never reached the C2 transverse foramen and

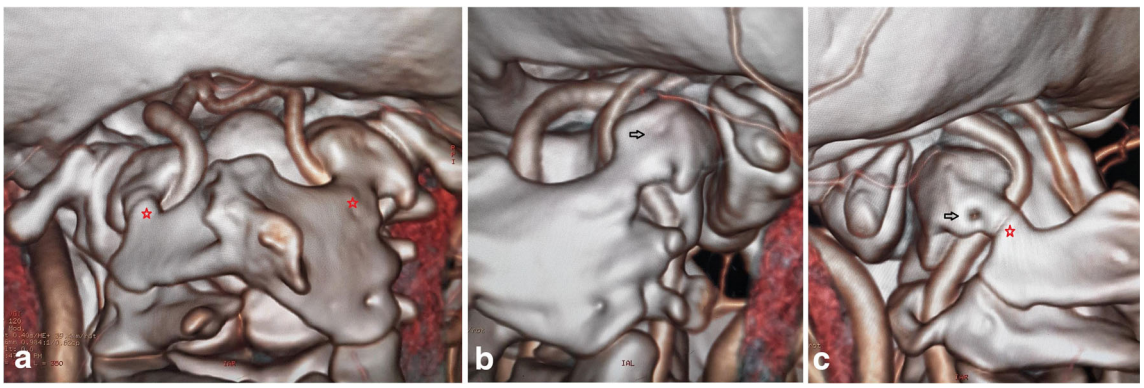

Fig. 2 Preoperative 3D CT angiography**:** Posterior (**a**), right (**b**), and left (**c**) oblique views show that the vertebral arteries on both sides course medially below C2 pars after their exit from the corresponding C3 transverse foramen. Note that bilateral C2 foramen transversarium are atretic (arrow) and the arteries do not enter them. The arteries are seen traversing anterior to the congenitally fused C2–3 facet joint (asterisk)

coursed medially towards foramen magnum after its exit from C3 transverse foramen.

Embryologically, the VA arises from a long anastomotic channel that interconnects the seven cervical intersegmental arteries [1]. The first part of VA develops from seventh intersegmental artery. During development, the other intersegmental arteries involute and vertical channels persist to form the normal VA. Depending on the abnormalities in involution, various anomalies of V3 segment may occur. A persistent first intersegmental artery is one in which the VA after exiting the C2 foramen transversarium passes below the C1 posterior arch instead of its normal course through C1 transverse foramen [3].

The VA anomaly described here is entirely different from the previously reported ones. The VA on both sides, after exiting the corresponding C3 transverse foramen passed medially and below the C2 isthmus in proximity to pars interarticularis. The bilateral second intersegmental artery (between C2 and C3) might have persisted giving rise to this anomaly. Both the transverse foramina of C2 were also atretic.

Correctly identifying this anomaly on CTA has management implications. Here, the VA hugs the thin pars interarticularis of C2. A screw that violates the C2 inferior wall is likely to injure the VA. Therefore, placing a transarticular or pars screw may not be a good choice in these cases, as a bony breach inferiorly could be disastrous. In such cases, we suggest placing a C2 pedicle screw. This way, the chance of injuring the VA is minimal. A neuronavigation guided screw placement may further minimize the risk. The other option for such VA anomaly would be inserting translaminar screws albeit with a slightly inferior biomechanical stability.

In presence of anomalous VA, fusing the occipital squama to cervical spine (OC fusion) is an alternative. However, this hampers the neck movements adversely affecting the quality of life and may have delayed complications [2, 8]. In our patient, the C0–C1 joint was intact. There was also congenital fusion of C2–3 along with block vertebrae from C4 to C6 with limited active cervical motion segments. Therefore, we decided to proceed with the shortest fixation possible (i.e., C1–C2) to avoid further restriction of neck movements. Thus, the report also illustrates the feasibility of short segment fusion even in the presence of such anomalous VA.

To conclude, we report a new variant, .i.e., bilateral persistent second intersegmental artery of VA. Knowledge of such VA anomaly is relevant in planning the type of fixation in congenital AAD. CT angiography is the mainstay in identifying these anomalies. The technique of C2 screw placement has to be adapted as illustrated in the present case.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Statement of informed consent Informed consent was obtained from patient.

References

1. Bavinck JN, Weaver DD (1986) Subclavian artery supply disruption sequence: hypothesis of a vascular etiology for Poland, Klippel-Feil, and Möbius anomalies. Am J Med Genet 23:903–918
2. Salunke P (2018) "Fusing the appropriate" in complex craniovertebral junction anomalies. Neurol India 66:151–152
3. Salunke P, Futane S, Sahoo SK, Ghuman MS, Khandelwal N (2014) Operative nuances to safeguard anomalous vertebral artery without compromising the surgery for congenital atlantoaxial dislocation: untying a tough knot between vessel and bone. J Neurosurg Spine 20:5–10
4. Salunke P, Sahoo S, Deepak AN (2015) Anomalous vertebral artery is not a deterrent to C1-2 joint dissection and manipulation for congenital atlantoaxial dislocation. Neurol India 63:1009–1012
5. Salunke P, Sahoo S, Khandelwal NK, Ghuman MS (2015) Technique for direct posterior reduction in irreducible atlantoaxial dislocation: multi-planar realignment of C1-2. Clin Neurol Neurosurg 131:47–53
6. Salunke P, Sahoo SK, Deepak AN, Ghuman MS, Khandelwal NK (2015) Comprehensive drilling of the C1-2 facets to achieve direct posterior reduction in irreducible atlantoaxial dislocation. J Neurosurg Spine 23:294–302
7. Salunke P, Sahoo SK, Ghuman MS (2014) Bilateral inverted vertebral arteries (V3 segment) in a case of congenital atlantoaxial dislocation: distinct entity or a lateral variant of persistent first intersegmental artery? Surg Neurol Int 5:82
8. Salunke P, Sahoo SK, Sood S, Mukherjee KK, Gupta SK (2016) Focusing on the delayed complications of fusing occipital squama to cervical spine for stabilization of congenital atlantoaxial dislocation and basilar invagination. Clin Neurol Neurosurg 145:19–27