A case of midline defect of posterior arch of atlas in a cadaver

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Abstract

During a routine osteology class for undergraduate students in Government Medical College, Kozhikode, Kerala, a median defect of posterior arch was found in the atlas of a cadaver. It was not a fracture as the edges were regular, round and smooth. There was no associated anomalies. These midline defects of posterior arch of atlas are sub divided both morphologically (types A-E) and clinically (sub groups 1-5) depending on the extent of absence of posterior arch and presence or absence of the posterior tubercle. The author presents a rare anomaly of a posterior arch partial aplasia which could be congenital. Since major neurologic deficits can be produced by a minor trauma, it is crucial to recognize this anomaly.

Keywords: aplasia, posterior tubercle, anomalies

Introduction

Posterior arch of atlas corresponds to laminae of other cervical vertebrae. Just behind lateral mass, the upper surface of posterior arch presents a wide groove for lodgement of 3\textsuperscript{rd} part of vertebral artery and first cervical nerve. Almost all cases of absence have been discovered incidentally\(^1\).

It seems to be a principle in morphology that the greater the amount of specialization of function manifested by any organ, the farther does the structure so specialized depart from the form of the primordial type to which it belongs. This principle is particularly exemplified in the case of the atlas and the axis, as, on account of the special varieties of motion in this region, the different parts are so modified that it is in some instances difficult to assign to the processes of these bones their exact positions as serial homologues of the processes in other vertebral segments\(^2\).

Case report

During a routine osteology class for undergraduate students in Government Medical College, Kozhikode, Kerala, a median defect of posterior arch was found in the atlas of a cadaver. It was not a fracture as the edges were regular, round and smooth. There were no associated anomalies (Fig.1).

Discussion

The atlas is formed from three primary ossification centres: an anterior ossification centre that forms the anterior tubercle and two lateral centres that form the lateral masses and the posterior arch\(^3\). Two centres at the lateral masses extend posteromedially to form the posterior arch usually in the fourth year. In about 2\% of the population, the fourth ossification centre forms a posterior tubercle between the two neural arches around the second year of life\(^4\).

During ossification, different anomalies can develop comprising:

- median cleft(s) of the posterior arch
- varying degrees of posterior arch dysplasia either with or without presence of posterior tubercle

Fig. 1.: Showing midline defect of posterior arch of atlas
Fusion of ossicles usually occurs at the age of 3 to 5. Incomplete posterior fusion may even be normal in children up to 10 years of age.\(^5\)

Defects of the posterior arch are thought to occur due to a failure of local chondrogenesis rather than due to subsequent ossification. This suggestion has been supported by the finding that the connective tissue bridges the bony defect. Malformations of the atlas include both clefts and aplasias.\(^6\)

**Classification**

They are subdivided both morphologically (types A-E) and clinically (subgroups 1-5) depending on the extent of absence of posterior arch and presence or absence of the posterior tubercle according to Currarino.\(^7\)

It should not be confused with Currarino triad (an inherited congenital disorder of the sacrum and anus or rectum).

These five types include:

**Morphological types:**

A: failure of posterior midline fusion of the two hemiarches
B: unilateral defect
C: bilateral defect
D: absence of the posterior arch, with persistent posterior tubercle
E: absence of the entire arch, including the tubercle

**Clinical sub-groups:**

1: incidental imaging finding, asymptomatic
2: neck pain or stiffness after trauma to the head or neck
3: chronic symptoms referable to the neck
4: various chronic neurological problems
5: acute neurological symptoms after minor cervical trauma

Type A and subgroup 1 are by far the commonest (approximating 80% of cases).\(^8\)

**Fig. 2.** Showing five morphological types of midline defects of posterior arch of atlas

According to this classification, the reported case belongs to type A. Type A occurs in 5.4% of the population and 97% of all posterior arch defects. Types B through E have been reported to occur in 0.69% of the population. These disturbances have been attributed to anomalies in the cartilaginous preformation of the posterior arch rather than to disturbances of ossification.\(^9\)

Richardson et al\(^9\) were the first to propose a mechanism by which neurological deficits occur. They emphasized that the isolated posterior fragment moved anteriorly and that when the neck was extended, the traumatized dorsal spinal cord caused inward buckling of the ligaments.

Sharma, Shailesh and Gaikwad et al\(^10\) reported the imaging findings in three symptomatic cases of partial aplasia of the posterior arch of the atlas with an isolated posterior remnant of the arch. The patients complained of neck pain and upper limb paraesthesia. Superimposed
canal stenosis was found in all three patients, but cord changes were only present in two patients.

It has been shown, both by autopsy studies and surgical findings, that the bony gap in the posterior arch of these patients is bridged by loose connective tissue rather than cartilage\(^{11}\).

Reported incidence in one larger series from 1930 was 4%\(^{12}\). Estimates from a recent extensive review range from 0.7-3%\(^{13}\).

Torriani et al\(^{14}\) reported an adult female without neurological symptoms presenting with an absent posterior arch.

Association with congenital anomaly of the posterior arch of the atlas have been reported in several disorders, including: Arnold Chiari malformation; gonadal dysgenesis; Klippel-Feil syndrome; Down syndrome and Turner syndrome. For asymptomatic cases, no treatment or follow-up is needed, as it is considered as a benign anatomical variant\(^{14}\).

Total or partial aplasia of the posterior atlas arch is rare\(^{15}\). The true incidence is not known, and only a few articles report on this particular malformation. Compensatory hypertrophy of the anterior arch of C1 and of the spinous process of C2 is usually found. Wysocki quoted the work of Li, who reported different variants and developmental defects of the atlas to occur together, especially in families by hereditary transmission\(^{16}\).

The incidence and clinical implications of congenital defects of atlantal arch was studied by Park et al\(^{17}\). The type A posterior arch defect was found in nine patients and the type B posterior arch defect was found in two patients. No type C, D, or E defects were observed. One patient with a type A posterior arch defect had an anterior atlantal-arch midline cleft (1/1153, 0.087%).

While most are asymptomatic and present as incidental finding on imaging studies performed after trauma or for other reasons, severe symptoms such as intermittent tetraparesis after minor cervical trauma have been described in the literature\(^{18}\). When patients with arch anomalies present with trauma, the radiographs may be confusing and misleading. Hence thorough knowledge of these anomalies is essential to avoid misinterpretation as osteolytic lesion, fracture or dislocation, e.g. atlantoaxial subluxation.

Familiarity with this abnormality may aid medical professionals in the correct management of these cases. Some authors including Curraro suggest advising patients with type C and D to avoid contact sports. Prevention of cumulative damage to the cord by surgery at an early stage may also be prudent in these types with posterior tubercle\(^{5}\). However, in patients with neurological symptoms, we believe magnetic resonance imaging should be performed in order to adequately evaluate the spinal cord and adjacent neural structures.

**Conclusion**

The author presents a rare anomaly of a posterior arch partial aplasia which could be congenital. Since major neurologic deficits can be produced by a minor trauma, it is crucial to recognize this anomaly.

**References**


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