

Description of “Ponticular Artery” at the atlas: an anatomical case report with potential clinical relevance

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SUMMARY

The atlas plays an important role as a characteristic connective bony element between the cervical spine and the occiput. Its details and variations are of special interest to neurosurgeons — e.g., in a far lateral transcondylar approach. We investigated 121 atlases and their variations. During our investigations, we periodically found atlases with a complete arcuate foramen (canal for vertebral artery) and an additional foramen in the bony roof of a complete arcuate foramen. Different structures passing through this additional foramen are described in the literature, but no artery. We found a macroscopically clear verified artery in a 67-year-old male cadaver passing through the foramen in the bony roof of a complete arcuate foramen. Such an artery is of clinical importance to neurosurgeons or musculoskeletal surgeons, but unmentioned in literature until now. A potential name for this artery could be “ponticular artery”. The discovered artery is most likely a branch to the neck muscles. The knowledge of a possible existence of such an artery is necessary to prevent complications during surgical procedures in the region of the upper cervical spine. Furthermore, the special course of this artery could be the reason for atrophy and imbalance of deep cervical muscles and consequently headaches.

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INTRODUCTION

The atlas plays an important role as a characteristic connective bony element between the cervical spine and the occiput. Its details and variations, especially regarding the region of the posterior arch and the adjacent area of the vertebral artery, are of special interest to neurosurgeons or musculoskeletal surgeon — e.g., in far lateral transcondylar approaches. This procedure is the method of choice to access the area of the lower clivus, the anterior part of the foramen magnum, the upper cervical spine, and the ventrolateral brainstem. Depending on the location of the lesions different variations of this approach are defined (Avic et al., 2000; Salas et al., 1999).

We investigated the atlas and its variations, particularly the occurrence of a complete arcuate foramen (canal for vertebral artery) and foramina in its bony roof (the ponticulus) because literature differs widely on that matter. During investigation we incidentally found the “ponticular artery”.

CASE REPORT

During courses, 121 atlases of incompletely dissected cadavers were investigated. All specimens were gained from body donors who had given their written informed consent to participate in anatomical studies during their lifetime. They were embalmed using Thiel’s method and did not show

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obvious signs of surgical procedures in the area of interest (Thiel, 1992; Thiel, 2002).

During our investigations, we periodically found atlases with a complete arcuate foramen (canal for vertebral artery) and an additional foramen in the bony roof of a complete arcuate foramen. This is illustrated in Fig. 1.

The foramen in the bony roof is named “foramen atlantoideum interponticulare” in one article (Yamasaki et al., 2003). We found a macroscopic clearly evident artery in a 67-year-old male cadaver passing through that sort of foramen in the bony roof of a complete arcuate foramen. The vessel had a diameter of 1.2 mm and showed a strictly vertical course. Due to the nature of the dissection program, the artery had already been severed, and therefore its further course could not be investigated. Such an artery is of clinical importance to neurosurgeons or musculoskeletal surgeons, but unmentioned in literature until now. This is illustrated in Fig. 2.

A potential name for this artery could be “ponticular artery” or in Latin nomenclature “Arteria ponticularis”.

DISCUSSION

The atlantic part of the vertebral artery (V3) has recently been structure of interest in several studies. Fortuniak et al. (2016) found low incidence of anatomical variations in this segment during their computer tomographic trial. However, variations as duplication or fenestration of the vessel are of great importance during surgical interventions in this region (Polguy et al., 2013). Further, Alfaouri-Kornieieva et al. (2012) stated that variability of V3 correlates with the respective skull shape.

Moreover, different structures passing through



Fig 1. Atlas, cranial - posterior view: complete arcuate foramen (canal for vertebral artery) with a foramen in its bony roof on the right side.



Fig 2. Atlas, lateral left view: branch of the vertebral artery passing through the bony roof of a complete arcuate foramen (“ponticular artery”).

the “foramen atlantoideum interponticulare” are described in the literature, but no artery. Yamasaki et al. (2003) described intercondylary veins as its content. Paraskevas et al. (2005) reported a passage of the suboccipital nerve and minor venous branches through this foramen. However, during further extensive review of the literature no report of an artery passing through the foramen in the bony roof of the complete arcuate foramen was found.

A review of the literature concerning the atlantic part (V3) of the vertebral artery offered that several arterial branches to surrounding structures were described. Tubbs et al. (2009) reported branches to muscles, osteoarticular branches, as well as meningeal, medullary, and radicular branches. Lanz and Wachsmuth (1979) described that most branches near the lateral mass are muscular branches for the deep regional cervical muscles. These vessels are able to build anastomoses with the occipital artery, the ascending cervical artery and the deep cervical artery as well. Grand and Hopkins (1999) described a number of small branches of the vertebral artery in the region of the posterior arch of the atlas. However, none of them passes through the bony roof of the complete arcuate foramen, and regarding these findings, the discovered artery is most likely a branch to the neck muscles.

The possible existence of such an artery is of importance against the background of the following facts: in various surgical procedures of this particular area — e.g., a far lateral transcondylary approach to reach lesions of the lower clivus, the anterior part of the foramen magnum, the upper cervical spine or the ventrolateral brainstem — the knowledge of a possible existence of an artery penetrating a “foramen atlantoideum interponticulare” is absolutely necessary. Otherwise this “ponticular artery” could be harmed during surgery

followed by complications.

Based on the assumption that it is a muscular branch, supplying the deep cervical muscles, a compression of the artery in consequence of a tight osseous canal in the bony roof could cause a unilateral reduced perfusion resulting in muscular atrophy of the deep cervical muscles. A muscular imbalance within this region is a potential cause for headaches.

The knowledge of a possible existence of an artery penetrating a foramen in the bony roof of a complete arcuate foramen is necessary to prevent complications during surgical procedures in the region of the upper cervical spine.

Furthermore, the special course of this artery could be the reason for atrophy and imbalance of deep cervical muscles and consequently headaches.

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