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Neurovascular relationship between abducens nerve and anterior inferior cerebellar artery

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We aimed to study the neurovascular relationships between the anterior inferior cerebellar artery (AICA) and the abducens nerve to help determine the pathogenesis of abducens nerve palsy which can be caused by arterial compression. Twenty-two cadaveric brains (44 hemispheres) were investigated after injected of coloured latex in to the arterial system. The anterior inferior cerebellar artery originated as a single branch in 75%, duplicate in 22.7%, and triplicate in 2.3% of the hemispheres. Abducens nerves were located between the AICAs in all hemispheres when the AICA duplicated or triplicated. Additionally, we noted that the AICA or its main branches pierced the abducens nerve in five hemispheres (11.4%). The anatomy of the AICA and its relationship with the abducens nerve is very important for diagnosis and treatment. (Folia Morphol 2010; 69, 4: 201–203)

Key words: abducens nerve palsy, neuroanatomy, vascular compression

INTRODUCTION

Vascular disorders, infections, tumours, diabetes mellitus, and traumas are the most common causes of abducens nerve palsy, occasionally accompanied with other cranial nerve disorders, especially regarding facial and trigeminal nerves. The reason for isolated abducens nerve palsy could be the result of vascular disorders such as aneurysms or vascular compression in the root exit zone [4, 6, 11, 13]. The anterior inferior cerebellar artery (AICA) is closely related to the abducens nerve. In this study we aimed to describe this relationship and discuss its clinical significance.

MATERIAL AND METHODS

Twenty-two human cadaveric brains were used in this study. Basilar and internal carotid arteries were separately cannulated and injected with coloured latex. The brains were embalmed in 10% formalin solution after injection. The dissections were performed using a surgical microscope (Opmi 99; Carl Zeiss, Gottingen, Germany). The origin of the AICA from the basilar artery and the relationship with the abducens nerve were investigated.

RESULTS

The AICA was present in each of the 44 hemispheres. All of the AICAs originated from the basilar artery (BA), usually from its lower parts. It originated as a single artery in 33 hemispheres (75%), duplicate (two arteries) in 11 hemispheres (22.7%), and triplicate (three arteries) in 1 hemisphere (2.3%). The AICAs bifurcated into two main branches as rostral and caudal trunks in single trunks, which were present in 33 hemispheres. The AICAs or their branches were in contact with the

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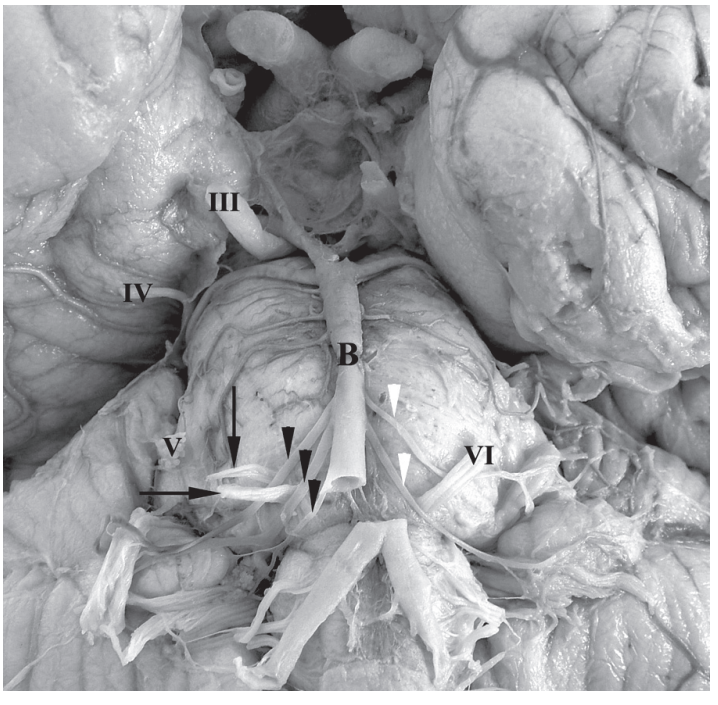

Figure 1. Anterior aspect of the brainstem with the vertebrobasilar system. Duplicated anterior inferior cerebellar artery (AICA) at the left and triplicated AICA at the right. Right abducens nerve pinched by AICA; black arrowheads — triplicate originated AICA; white arrowheads — duplicate originated AICA; B — basilar artery; III — oculomotor nerve; IV — trochlear nerve; V — trigeminal nerve; VI — abducens nerve, black arrows: different divisions of the abducens nerve separated by AICA.

abducens nerve in all hemispheres. The AICAs which originated as a single trunk from the basilar artery coursed at the dorsal aspect of the abducens nerve in 24 hemispheres (72.7%) and extended to the ventral aspect in 9 hemispheres (27.3%). The abducens nerve was located between the AICAs in the hemispheres in which the AICAs were duplicated.

The abducens nerve was penetrated by the upper branch of the triplicated AICA (Fig. 1). We observed that the AICA or its main branches pierced the abducens nerve in five hemispheres (11.4%), including the triplicated one.

DISCUSSION

Martin et al. [8] observed single AICA 72%, duplicated AICA 26%, and triplicated AICA 2% in all cases in their study. Marinkovic et al. [7] also found single AICA 64.28% and duplicated AICA 35.71% in all the cases in their study, but they did not note any triplicated AICA. Our results are similar to those of these researchers. In our series, triplicated AICA was seen in 2.3% of cases. This was in contrast to the findings of Yasargil [17] who noted 20% of the AICAs originated as triplicate.

Arterial penetration of the abducens nerve has been mentioned in literature [7, 14, 15]. While Nathan et al. [12] and Yasargil [17] described it as a rare phenomenon, Marinkovic et al. [7] showed that the AICA penetrated 25% of the abducens nerves. According to our results, penetration of the abducens nerve by AICA was neither a very rare situation, as described by Nathan et al. [12] and Yasargil [17], nor a common situation as mentioned in the study by Marinkovic et al. [7]. In our study, the AICA or its main branches contacted either the dorsal or ventral aspect of the abducens nerve in all hemispheres. We believe that these relationships with the AICA and abducens nerve may be a potential cause of abducens nerve palsies. Abducens nerve palsies usually accompany other cranial nerve issues and can be caused by various factors like ischaemia, haemorrhage, aneurysm, trauma, tumour, arteriovenous malformation, and postoperative complication [1–3, 6, 9, 10, 13, 15]. Isolated abducens nerve palsy is a rare situation. This situation generally results from arterial disorders, especially vascular compression, and in some cases the aetiology is unclear [3, 6, 10, 11, 13]. Most studies indicate isolated abducens nerve palsies as a result of basilar or ver-

tebral arteries disorders [3–5, 11, 16, 18]. We think that the close relationship with the AICA and abducens nerve must be evaluated during diagnosis and treatment of isolated abducens nerve palsies, and this must be kept in mind especially in cases with penetration of the abducens nerve by the AICA or its branches when the aetiology is unclear.

CONCLUSIONS

Isolated abducens nerve palsy is a rare condition which is a potential result of vascular disorders in the root exit zone. Different treatment options are available for cranial nerve pathologies, but if these pathologies are related to vascular disorders, pharmacological treatment may be ineffective. In these conditions, surgical procedures such as microvascular decompression could be a good option. AICA or its main branches are closely related with the abducens nerve and these could be a potential cause of abducens nerve pathologies such as palsies or pareses. Due to this, the anatomy of the AICA and its relationship with the abducens nerve is very important for diagnosis and treatment. We believe that this anatomical study will be helpful to comprehend the clinico-anatomical correlations.

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