



## Case Report

# Anatomic Variation of Vertebrobasilar System and Its Branches: Case Report

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**Citation:** Dalçık C, Sen E, Madivala S, Dalçık H (2022) Anatomic Variation of Vertebrobasilar System and Its Branches: Case Report. Ann Case Report 7: 950. DOI: 10.29011/2574-7754.100950

**Received Date:** 13 September 2022; **Accepted Date:** 17 September 2022; **Published Date:** 20 September 2022

### Abstract

To describe aberrant dominant and hypoplastic vertebral (VA) arteries and duplicated posterior inferior cerebellar artery (PICA) and anterior inferior cerebellar artery (AICA). Artery sections of 5 µm were obtained for morphological and microscopic examinations. Sections were stained with Masson's trichrome and histological examination was performed under the light microscope. During routine dissection in the department of Anatomy, the presence of a very thin hypoplastic right VA, the left dominant VA was continuous with the basilar artery, and both duplicate of left PICA and left AICA were observed. We examined the histological sections of the dominant and hypoplastic VA. The external diameters of the left VA were over 2 times more than the right one. Understanding the variation of the arterial vertebrobasilar system may influence the surgical procedures and better appreciate the arterial flow of the right and the left-brain in clinical care. This is the first report concerning the dominant and hypoplastic VA and duplicate PICA and AICA at the same time in one cadaver.

**Keywords:** Anatomic variation; Vertebral artery; Basilar artery; Posterior inferior cerebellar artery; Anterior inferior cerebellar artery

### Introduction

The vertebrobasilar system is composed of bilateral vertebral arteries (VA), unpaired basilar artery (BA) and its branches, which, supplies the cervical spinal cord, brainstem, cerebellum, thalamus, and occipital lobes. Clinically, it has been shown that, any presence of occlusion, stenosis, or low amount of blood flow in the VA, BA or its branches may lead to the vertebrobasilar arterial insufficiency [1]. There are studies that show decreased diameter of the VA is closely related to some clinical features such as vertigo, migraine, and tinnitus [2]. In the present case, at the vertebrobasilar junction a dominant and hypoplastic VA and, duplicate PICA and AICA

was observed at the same time in one cadaver. We believe that the findings of the present case of aberrant vessels may influence the surgical procedures and better appreciate the arterial flow of the right and the left-brain in clinical care.

### Material and Methods

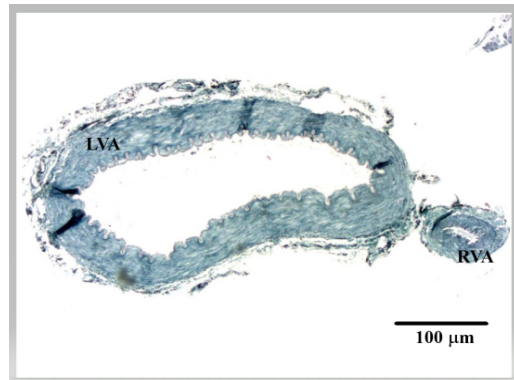
#### Histology

The right and left VAs were dissected. They were fixed in 10% formalin and embedded in paraffin. 5 µm sections were obtained using a microtome. The sections were stained with Masson trichrome and histological examination was performed under a light microscope.

### Results and Case Report

During routine dissection of head of 75-year-old male

cadaver we observed the intracranial segment of right VA diameter was thinner (hypoplastic) than the intracranial segment of left VA (dominant). The diameters of the two intracranial segments of VA's were measured. The external diameters of the left VA were approximately 5 mm, the diameter of the right one was measured approximately 2 mm. The BA was viewed as a continuation of the dominant left VA (Figure 1). In addition, on the right side one PICA coming out from the hypoplastic VA and one AICA coming out from the BA (Figure 1). On the left side two PICA (#1 and #2) coming out from the dominant left VA and two AICA (#1 and #2) coming out from the left BA (Figure 1). The left #1 PICA appear to branch off from the similar level of the right PICA. The #2 PICA was branching off from a higher level approximately at the level of hypoplastic right VA. #1 left AICA was branching off from the BA similar level of the right AICA. #2 AICA was branching off from a higher level from the BA (Figure 1). The diameter of the hypoplastic right VA were similar or littler larger than the diameter of the PICA and AICA of both sides (Figure 1).

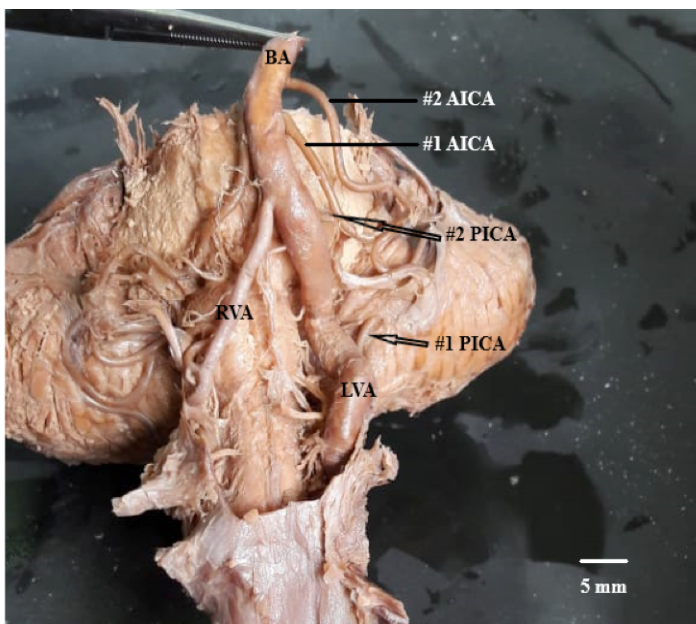


**Figure 2:** Histological examination of the bilateral vertebral arteries was stained with Masson trichrome, original magnification X 200. The dominant LVA (left vertebral artery) and the hypoplastic RVA (right vertebral artery). In contrast to RVA, the LVA showed thick tunica media with concentric layers of green-stained smooth muscle layer.

## Discussion

In the present case, at the vertebrobasilar junction a dominant and hypoplastic VA and, duplicate PICA and AICA was observed on a 75-year-old male cadaver during a routine dissection. On the left side two PICA was coming out from the dominant left VA and two AICA coming out from the left BA. It is crucial to note that vertebrobasilar arterial system contains important arteries that supplies the spinal cord, cerebellum, brain stem, inner ear, and cerebrum.

It has been demonstrated that anatomical variations in the vertebrobasilar arteries was closely correlated with the occurrence of the VA dissection [3]. This variation may affect the hemodynamic outcomes of the vertebral flow and the blood supply of the brain stem, cerebrum, and the cerebellum. One of the hypotheses of the asymmetry is related to vascular requirements of the brain [4]. Asymmetry of the VA, with a larger left commonly occurring, has been reported by other authors [1, 5]. The normal size of VA's is 3-5mm. If it is < 2-3mm or diameter difference of > 1:1 it is defined as hypoplasia of the artery [5, 6]. Which is in correlation with our findings. In another study, the diameter of the left VA was bigger than the right VA in 73% of healthy population [7]. In the present case, the left VA being the dominant one and the right VA the hypoplastic. In addition, our results show, BA is a continuation of the left dominant VA rather than the union of the two VA's. Apparently, the structures supplied by the thin right VA may not receive enough blood supply compared to the structures supplied by the left VA. The microscopic features of the left VA had a medium sized and the right VA artery had a small sized artery characteristics. Furthermore, due to the structural



**Figure 1:** Note the RVA (right vertebral artery) is hypoplastic and the LVA (left vertebral artery) is the dominant artery, and the BA (basilar artery) is a continuation of the dominant LVA. On the left side two PICA (posterior inferior cerebellar artery; #1 and #2) coming out from the dominant LVA and two AICA (anterior inferior cerebellar artery #1 and #2) coming out from the left BA.

Other than these findings, the cadaver did not have any abnormal features and was regarded as a healthy specimen.

According to the histological features (Figure 2), the dominant left VA was regarded as medium sized muscular artery, and the right hypoplastic VA was regarded as small sized VA.

variations turbulent flow of the blood due to pressure differences may lead to risks of thrombosis, intracranial aneurysm formation and dissection [8].

The asymmetry and the duplications of the arteries may be related to vascular requirements of the structures could lead to the asymmetry during the embryological development [1,8]. This dominancy was apparent on one side since there were additional PICA and AICA in the dominant side. The duplicate of these arteries may be the result of the increased diameter and hence high blood volume and blood flow may have triggered the formation of the extra branches. This case is the first to show all the mentioned variations in one cadaver with a duplicated PICA and AICA and dominant and a hypoplastic VA at the same time. Having two left PICA's and two left AICA's supplying the mentioned structures shows that the left side brain areas was getting more blood than the right [3,9]. Having two-left PICA and two left AICA causes the left side to supply more than the other side [5], which appears to be advantageous, however, may also contain a risk factor for aneurysms [4].

## Conclusion

In the literature, anatomical variations of vertebrobasilar vasculature are scarce. It is crucial to note the presence of clinically important vertebrobasilar artery variations before any endovascular intervention. This is the first report concerning the dominant and hypoplastic VA and duplicate PICA and AICA at the same time in one cadaver.

## Acknowledgements

The authors sincerely thank those who donated their bodies to science so that anatomical research could be performed. Results from such research can potentially increase humankind's overall knowledge that can then improve patient care. Therefore, these donors and their families deserve our highest gratitude.

## Declarations

**Ethical approval:** Conducting scientific studies on cadavers or cadaveric body parts does not require ethical approval in our university.

**Competing interest:** The authors of this case report declare no financial or non-financial interest or relationships with any companies, whose products or services may be related to the subject matter of the article.

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