Original Research

Morphological Study of Basilar Artery and Its Variations in The Local Population: A Dissection Based Approach

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ABSTRACT

Background: The brain gets its blood supply from two sources, namely, internal carotid system and vertebrobasilar system of arteries. Right and left internal carotid arteries enter the carotid canal and reach the base of the brain. Here, they anastomose with vertebrobasilar system of arteries to form the circle of Willis. This study was conducted for morphological assessment of basilar artery and its variations in the local population.

Materials and Methods:Forty cadavers—20 female as well as 20 males—were dissected. The typical dissection manual approach was used while removing the brains. The surplus preservatives were removed from the brains by giving them a thorough water wash. In order to avoid disturbing any blood vessels, the arachnoid mater was gently removed from the base of the brain.

Results: Level of formation of basilar artery was at pontomedullary junction in 32 subjects. Level of formation of basilar artery was above and below pontomedullary junction was in 5 and 3 cases, respectively. Level of termination of basilar artery was at pontomesencephalic junction, above as well as below pontomesencephalic junction in 31, 5 and 4 cases, respectively.

Conclusion: The basilar artery's length as well as diameter showed no gender propensity. Surgeons will benefit from the baseline data established in this study regarding the length, diameter, level of origin, and level of termination of the basilar artery.

Keywords:Basilar Artery, Variations, Morphology, Inflammation, Fibrosis.

INTRODUCTION

The brain gets its blood supply from two sources, namely, internal carotid system and vertebrobasilar system of arteries. Right and left internal carotid arteries enter the carotid canal and reach the base of the brain. Here, they anastomose with vertebrobasilar system of arteries to form the circle of Willis. The vertebrobasilar system of arteries is formed by right and left vertebral arteries (RVA and LVA). Vertebral artery ascends through the foramen transversarium of upper six cervical vertebrae and enters the skull through the foramen magnum. The RVA and LVA ascend medially and anteriorly to join each other at the level of the pontomedullary junction (PMdJ) to form BA. BA runs upward and forward in the median groove of pons and divides into two posterior cerebral arteries at the pontomesencephalic junction (PMsJ).[1]Several studies have shown that these variations play an important role in the development of cerebrovascular diseases.[2] Anatomical variations are probably genetically determined, develop in early embryonic stage and persist in post-natal life.[3] Any change in the normal morphology of the circle may condition the appearance and severity of symptoms of cerebrovascular disorders, such as aneurysms, infarcts and other vascular anomalies.[4] Arterial aneurysms such as berry aneurysms and arterial variations are interconnected. Aneurysms usually tend to occur at branches or at the bifurcations of cerebral arteries.[5] There is a possible link between the anomalies of

circle of Willis and the mentally ill and patients with cerebrovascular catastrophy.[6-8]This study was conducted for morphological assessment of basilar artery and its variations in the local population.

MATERIALS AND METHODS

Forty cadavers—20 female as well as 20 males—were dissected. The typical dissection manual approach was used while removing the brains. The surplus preservatives were removed from the brains by giving them a thorough water wash. In order to avoid disturbing any blood vessels, the arachnoid mater was gently removed from the base of the brain.

RESULTS

Level of formation of basilar artery was at pontomedullary junction in 32 subjects. Level of formation of basilar artery was above and below pontomedullary junction was in 5 and 3 cases, respectively.Level of termination of basilar artery was at pontomesencephalic junction, above as well as below pontomesencephalic junction in 31, 5 and 4 cases, respectively.

Table 1: Variation in level of formation of basilar artery

Level of formation	Number of cases
At pontomedullary junction	32
Above pontomedullary junction	05
Below pontomedullary junction	03
Total	40

Table 2: Variation in level of termination of basilar artery

Level of termination	Number of cases
At pontomesencephalic junction	31
Above pontomesencephalic junction	05
Below pontomesencephalic junction	04
Total	40

DISCUSSION

Some commonly documented variations in basilar artery distribution exist. One of these variations includes persistent carotid-basilar artery anastomosis. Several cadaveric studies put the incidence of this variation at less than 0.5%. A persistent trigeminal artery is the most commonly documented persistent carotid-basilar artery anastomosis, followed by the persistent hypoglossal artery. Other persistent carotid-basilar artery anastomoses are a persistent primitive optic artery and a persistent primitive pro-atlantal intersegmental artery. Another documented variation is a fenestrated basilar artery, wherein there are duplications of portions of the basilar artery.[11]There is documentation of perforation of the basilar artery from autopsies, with a prevalence rate as high as 5%. This perforated variation predisposes to basilar artery aneurysm. The labyrinthine artery, also called the internal auditory artery, typically arises from the AICA but may arise from the basilar artery in about 15% of cases. A hypoplastic basilar artery is a very rare condition often seen alongside a persistent carotid-basilar artery anastomosis. The posterior inferior cerebellar artery, which is typically a branch of the vertebral artery, may arise from the basilar artery in about 10% of cases.[12,13]This study was conducted for morphological assessment of basilar artery and its variations in the local population.In this study, level of formation of basilar artery was at pontomedullary junction in 32 subjects. Level of formation of basilar artery was above and below pontomedullary junction was in 5 and 3 cases, respectively. Level of termination of basilar artery was at pontomesencephalic junction, above as well as below pontomesencephalic junction in 31, 5 and 4 cases, respectively.Satapathy BC et al[9] provided a baseline database regarding length, mid-length diameter, level of origin, and level of termination of BA. Thirty-eight formalin-fixed brains were obtained from cadavers dissected for undergraduate studies. The external length and the average external diameter of BA were measured by a digital Vernier caliper. Variation in origin and termination of BA was noted using magnifying glass. The length and diameter of the BA were 25.58 ± 3.57 mm and 3.05 ± 0.41 mm, respectively. The origin and termination of BA was normal in most cases. In two cases, the origin was above the pontomedullary junction, and in one case, it was below. In two cases, the termination was above the pontomesencephalic junction, and in one case, it was below. There was no gender predisposition in length and diameter of the basilar artery. The baseline data established in this study regarding length, diameter, level of origin and level of termination of basilar artery will help neurosurgeons and interventional radiologists to diagnose as well as plan and execute various vascular procedures such as shunting for the treatment of aneurysms and stenosis in the blood vessels of the posterior cranial fossa.Cao S et al[10] identified the influence of BA curvature severity on the risk of PCI occurrence in patients without vertebrobasilar stenosis through a prospective cohort study. In this study, they enrolled 171 patients with BA dolichosis but without vertebrobasilar stenosis. The BA geometric parameters were evaluated on MRA. The primary outcome was the occurrence of PCI, mainly referring to cerebellar

and/or brainstem infarction. Cox proportional hazard models were used to detect possible predictors of PCI. Among them, 134 (78.4%) patients were diagnosed with BA curvature, including 124 with moderate curvature and 10 with prominent curvature. The defined PCI occurrence was observed in 32 (18.7%) patients with a median follow-up time of 45.6 months. Cox proportional hazard analysis showed that BA prominent curvature (HR = 6.09; 95% CI: 1.36–27.28; P = 0.018) significantly increased the risk of PCI occurrence and bending length (BL) was also significantly associated with PCI occurrence, with the adjusted HR per 1-mm increase of BL of 1.09 (95% CI: 1.01–1.18; P = 0.040). In the subgroup analysis stratified by age, BA prominent curvature was highly associated with PCI occurrence in patients aged > 61 years (HR = 11.76; 95% CI: 1.21–113.90; P = 0.033). Additionally, good antiplatelet therapy adherence could significantly reduce the risk of PCI occurrence. BA curvature may increase the risk of PCI occurrence, especially in elderly patients with prominent curvature. Improving adherence to antiplatelet therapy can help reduce the risk of PCI occurrence.

CONCLUSION

The basilar artery's length as well as diameter showed no gender propensity. Surgeons will benefit from the baseline data established in this study regarding the length, diameter, level of origin, and level of termination of the basilar artery.

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