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Research Article

Study of the variations of superior cerebellar artery in human cadavers

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ABSTRACT

Background: Superior Cerebellar Artery (SCA) arises just caudal to the bifurcation of basilar artery. The artery may be exposed in various neurosurgical procedures pertaining to the basilar apex, cerebellopontine angle, clivus etc. With the recent advances in neuroradiology and microvascular surgeries, the knowledge of the anatomical variations becomes very important for the neurosurgeons to perform the operations safely and successfully. Aim of current study was to study the morphometry and anatomical variations of the proximal segment of SCA (i.e. from its origin to its first bifurcation).
Methods: 150 SCAs were studied by gross dissection of 75 formalin embalmed brains obtained from the department of anatomy Mysore medical college and MVJ medical college over a period of 5 years.
Results: Variations like duplication in the origin was seen in 23.3%, triplication in 2% of SCAs, and abnormal origin from Posterior Cerebellar Artery (PCA) in 25.3% were noted. Other variations like tortuous course & fenestration of SCA were found. The distance from the origin of SCA to PCA ranged between 0.7-4.5 mm. The length from SCA origin to its bifurcation ranged from 6-23 mm. Outer diameter of SCA trunk at its origin varied from 1.2-2.8 mm. The outer diameter of the Basilar Artery (BA) at the basilar apex ranged between 3.2-6 mm.
Conclusion: The presence of variations can alter the plan of surgical and radiological procedures. The knowledge of such variations and anomalies along with potential clinical manifestations is of paramount importance primarily for neurosurgeons and neuroradiologists.

Keywords: Morphometry, Neurosurgery, Superior cerebellar artery, Variations

INTRODUCTION

Vertebrobasilar system and its branches constitute the posterior circulation of the brain. The anatomy of the posterior circulation is very complex and is subjected to variations.[1] Superior Cerebellar Arteries (SCAs) are the most consistent branches arising from the basilar artery just below or at the level of its bifurcation. It supplies some portion of the midbrain, the superior surface of the cerebellar hemispheres, the superior vermis, deep cerebellar white matter and dentate nuclei. Different variations like duplication, triplication, and unusual origin have been reported in the western literature.[2]

Aneurysms and stroke are the most common form of cerebrovascular diseases affecting mankind with a high degree of morbidity and mortality. The presence of arterial variations can be one of the factors attributed to aneurysms and thrombus formation leading to cerebellar infarcts.

The proximal segment of SCA is a potential bypass site for reconstructive and revascularization surgeries for vertebrobasilar insufficiencies.[3]

The present study was undertaken mainly to know the anatomical variations in the origin and dimensions of the proximal segment of SCA in south Indian population so that the data can be of benefit to the anatomist, radiologist and the neurovascular surgeons.

METHODS

Seventy-five cadaveric brains from both the sexes, of age ranging from 19-70 years. were studied during routine dissection in the department of anatomy Mysore medical college and MVJ medical college for a period of 5 years.

The brains were removed from the cranial cavity and were carefully washed with isotonic saline. The base of the brain including the brain stem with intact vertebrobasilar artery and its branches were fixed in 10% formalin for 15 days. Basilar artery, superior cerebellar and posterior cerebral arteries were dissected carefully under water, dried and painted with fevicryl red colour. SCA was analysed for the variations in the size, length and anomalies. The dimensions of the SCA and BA were measured using graduated vernier callipers (sensitivity: 0.1 mm, aerospace). The data obtained was statistically analysed. Variations noted were photographed using digital camera (Sony cybershot 14MP).

Statistical methods

Descriptive statistics is used for this study.

RESULTS

Superior cerebellar artery was present in all the 75 brain specimens (150 SCAs) examined. The variations pertaining to the number and form of origin are shown in Table 1 and Table 2 respectively. Among 150 SCA's studied, single SCA's were noted in 112 SCA's (74.6%) cases. Duplication was seen in 35 SCA's (23.3%) and triplication was noted in 3 cases (2%).

Table 1: Variations in the number of SCA (N=150).

Variations	Right	Left	Total
Solitary trunk	58	54	112
Duplication	15	20	35
Triplication	02	01	03

Table 2: Variation in the form of origin of 150 SCA in 75 cadaveric brains.

Variations in the origin of SCA	Right side	Left side	Total (N=150)
From basilar artery alone	58	54	112
Common trunk of origin of PCA-SCA	08	13	21
From common trunk with PCA & also basilar A.	09	08	17
Fenestrated SCA	Nil	1	01
Early bifurcation of SCA	07	5	12
Hypoplastic SCA (diameter <1 mm)	Nil	01	01

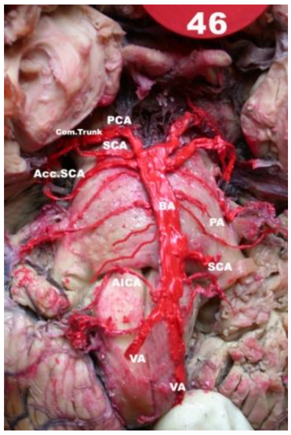

Figure 1: Duplication of the SCA with common trunk of origin with PCA.

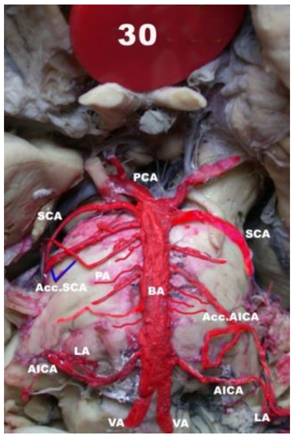

Figure 2: Triplication of SCA on the right side.

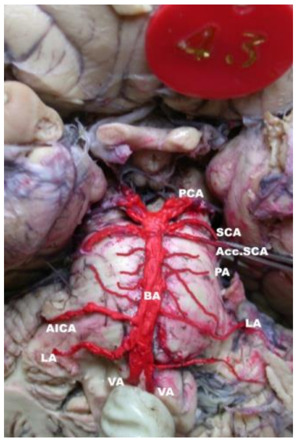

Figure 3: Early bifurcation of SCA on the left side.

BA = Basilar artery
SCA = Superior cerebellar artery
Acc. SCA = Accessory superior cerebellar artery
Com. Trunk = Common trunk of origin
PCA = Posterior cerebral artery
PA = Pontine artery
AICA = Anterior inferior cerebellar artery
LA = Labyrinthine artery
VA = Vertebral artery

The SCA was arising as a common trunk with PCA in 38 cases (25.3%) of which, in 17 cases SCA arose as common trunk as well as from the basilar artery.

Early bifurcation, fenestration and hypoplastic SCA were noted in 8%. 0.7% and 0.7% of the cases studied. SCA with diameter of <1 mm was considered to be hypoplastic. The outer diameter of main trunk of SCA at its origin was 1.9 ± 0.3 mm on the left side and 2.0 ± 0.4 mm on the right side.

The length of the SCA from its origin to its bifurcation into rostral and caudal branches ranged from 6-23 mm. The distance between SCA origin and PCA ranged between 0.7-4.5 mm. The outer diameter of the basilar artery (BA) at the basilar apex ranged between 3.2-6 mm.

The height of the basilar bifurcation was documented using the ponto-mesencephalic junction as the reference point. The bifurcation was considered to be normal if it occurred at the ponto-mesencephalic junction as seen in 33.3% of cases. High if it occurred anterior to the midbrain, above the ponto-mesencephalic junction as in 22.2% of cases and low if it was anterior to the pons below the ponto-mesencephalic junction as seen in 19.4% of the cases.

DISCUSSION

Superior cerebellar artery is the most consistent artery in terms of its origin and location. Normally the SCA arise from the basilar artery close to its bifurcation into two posterior cerebral arteries. The origin of SCA lies within the interpeduncular cistern and the oculomotor nerve intervenes between SCA and PCA. From its origin the artery curves encircling the brainstem and passes below the trochlear nerve and above the trigeminal nerve. The variations of the course of SCA can alter the relationship with the adjacent cranial nerves resulting in compression symptoms.[4,5]

The artery is divided into prepontine segment, ambient segment, quadrigeminal segment and cortical segments. The proximal SCA is intimately related to the III, IV and V cranial nerves. Anatomical variations of SCA may therefore present with palsies of these nerves. Tortuous and elongated SCA can compress the trigeminal nerve resulting in trigeminal neuralgia and microvascular decompression procedure (MVD) by wrapping technique is the latest treatment used for trigeminal neuralgia.[6]

In the present study we encountered a case of tortuous course of SCA touching the root entry zone of the V nerve.

The position of the trunk of the superior cerebellar artery in the perimesencephalic cisterns serves as a sensitive indicator of tumors located either intrinsic or extrinsic to the midbrain. This segment of the superior cerebellar artery may be displaced medially, posteriorly, anteriorly, or laterally by the avascular masses, meningiomas, aneurysms, arteriovenous malformations, atheromatous disease, or vascular neoplasms. Large extra-axial masses arising from the clivus or the cerebellopontine angle can impinge upon the anterior aspect of the midbrain displacing the first segment of the superior cerebellar artery towards the midline.[7]

SCA divides into rostral and caudal branches when originating solely from the distal basilar artery. Duplication is mostly encountered as two trunks originating from the basilar artery, with the superior trunk bearing rostral and the inferior trunk caudal branches respectively.[8]

Mennan Ece Aydin[2] in 2011 has reported that the duplication of the SCA was found in 28%, 20% and 25% of the cases as studied by Padget DH and Salamon G and Dagcinar et al. In the present study duplication was seen in 23.3% of the cases. Triplication was noted in 2% and 8% of cases as studied by Hardy DG and Mani RL respectively. 2% triplication was noted in our study.

Bilateral duplication is another variation that is very rare and considered to occur at a rate of 2%. Origin of the SCA from the PCA was found in 4% and 2.6% of cases examined by Hardy DG[4] and Uchino A et al. In the present study, we noted a very high incidence of this variation to the extent of 23.5% of cases.

The BA bifurcation is an important determinant of the initial course of SCA. In the 5-8 mm embryo the BA is formed by the fusion with the longitudinal neural arteries. Lack of normal fusion at the origin of the SCA, during development of the BA from the neural arteries and the PCA which connects the carotids and primitive neural arteries, anastomose with the BA caudally at a point lower than the normal site. These two ontogenetic interpretations explain the variations of the SCA.[2]

The rostral or caudal trunks of the SCA can be used for revascularisation procedures. The bifurcating trunks are most easily accessed utilizing a combined petrosal, lateral supracerebellar-infratentorial, or sub-temporal approach. Generally the largest trunk of the SCA is the rostral trunk, containing more perforating branches than the main trunk. Caudal trunk and marginal branch, and the rostral trunk more commonly comes in contact with IV cranial nerve. If the rostral trunk is to be used for revascularization, consideration should be given to the potential risk of injury to IV cranial nerve and the potential for perforator infarcts.[8]

The superior cerebellar artery represents an important arteriographic landmark in the diagnosis of posterior fossa lesions. Its position relative to the upper brain stem and superior cerebellum makes it of particular value in the assessment of lesions in and adjacent to these areas. The anatomical features and variations of the vertebrobasilar system and its branches helps in accurate interpretation of the ischemic areas, diagnoses of lesions, endovascular interventions, and posterior cranial fossa surgeries.[8] In the present study the SCA bifurcation was lateral to the brainstem in majority of the cases.

Arterial bypass procedure can be used in the treatment of vertebrobasilar ischemia, basilar artery stenosis, skull base tumors, and complex and giant arterio-venous malformation related to posterior circulation. In this procedure PICAs, AICAs, SCAs, or PCAs are anastomosed end-to-end, end-to-side, or side-to-side to the contralateral equivalent arteries or to the extra cranial arteries such as superficial temporal artery and the occipital artery to achieve the revascularization of the neural parenchyma. Large basilar apex aneurysm are treated by double-barrel anastomoses of the superficial temporal artery to the superior cerebellar artery (STA-SCA).[9,10]

Bypass procedures can reduce mortality and morbidity and the knowledge of the anatomic features like origin, diameter, and course of the vasculature plays an important role in preoperative planning of the appropriate branches and location for the anastomosis.[3,9-11]

In this study the outer diameter of the BA at its apex ranged from 3.2-6 mm. Shrontz C has recorded the outer diameter of the distal BA as 4.1 ± 0.1 mm and at the level of SCA origin as 3.5 ± 0.2 mm.

The outer diameter of the main trunk of the SCA was 1.9 ± 0.3mm on the left side and 2.0 ± 0.4 mm on the right side in this study. Whereas it was 1.5 ± 0.1 mm on the left side and 1.4 ± 0.1mm on the right side. In case of duplication the diameters of both the trunks of SCA measured were 1.1 ± 0.1 mm.

Diameter of the rostral trunk ranged from 0.5 -1.6 mm (avg. 1.1), and the diameter of the caudal trunk ranged from 0.4 -1.5 mm (avg. 0.98) in our findings.

The localization of most strokes can be determined through knowledge of vascular anatomy.

The underlying cause, the cerebrovascular anatomical variations, interarterial anastomoses, and the haemodynamic situation are the major factors that determine the location and extent of the infarcts. The underlying cause is primarily classified as embolism or thrombosis, and location is also mentioned.

While interpreting the cause and the outcome of the ischemic events, variations in origins, diameters, irrigation areas, and anastomoses of the arteries may lead to different clinical outcomes in different cases. The unfamiliarity with the common variations of the SCA may cause misinterpretation of the causes and results and lead to wrong management.[11-15]

CONCLUSION

It is important to know the variations of the SCA in planning arterial bypass procedures, interpretation of the cause and clinical symptoms and outcome of ischemic events and evaluation of radiological imaging. Recent advances in the endovascular and microsurgical techniques necessitate a thorough knowledge and understanding of the blood supply to the posterior fossa in order to treat the pathologies in this region safely without any iatrogenic complications.

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