

A STUDY OF VARIATIONS IN THE ORIGIN OF SUPERIOR CEREBELLAR ARTERY AND THE DIMENSIONS OF ITS PROXIMAL SEGMENT

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ABSTRACT

Background: Since many clinical conditions affecting the brain stem are the results of vascular lesions, profound knowledge of vertebrobasilar circulation is of utmost clinical importance. Variations in the origin of superior cerebellar artery (SCA) are frequently observed and these may play an important role in neurovascular compression syndrome, as III, IV and V cranial nerves are closely related to SCA. Being one of the frequent locations for aneurysms of posterior circulation, variations of SCA should be considered prior to any diagnostic or therapeutic procedures in basilar tip region.

Materials and Methods: The current study was conducted on 80 human cadaveric brain specimens to study the variant origin of superior cerebellar artery, its anomalies, and to measure the dimensions of proximal segment of SCA. The study was undertaken during routine dissection for the undergraduate students over a period of 5 years.


Results: 80 specimens, (i.e. 160 SCAs) were analysed. SCA arose from the basilar artery in 152 cases. In 3 cases SCA originated from posterior cerebral artery (PCA). SCA and PCA arose as common trunk in 5 cases. Out of 160 SCAs, it arose as a single vessel in 129 cases. Duplication was seen in 28 cases. Triplication was found in 3 cases. Outer diameter of SCA at its origin was 1.8 ± 0.5 mm on the right side. On the left side it was 1.6 ± 0.4 mm. The length of the proximal segment of the SCA ranged from 9 to 24 mm. The distance between SCA and PCA ranged from 0.6 mm to 3.2 mm.

Conclusion: Our study identified significant variations in the origin of SCA as well as the dimensions of its proximal segment. It would be useful for neuroradiologists in investigative procedures like CT, MRI and cerebral angiography. Neurosurgeons performing endovascular procedures for aneurysms and surgery for posterior fossa tumors will also benefit from this study.

KEY WORDS: Basilar Artery, Superior Cerebellar Artery, Proximal Segment, Duplication, Triplication Variations.

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INTRODUCTION

Superior cerebellar artery arises from the distal part of the basilar artery just proximal to the origin of PCA. It may also arise from PCA or it may arise from a common trunk along with PCA [1]. At first it is parallel to the PCA from which it

is separated by the oculomotor nerve and runs posterolaterally in the peri mesencephalic cistern, encircling the upper pons and lower mesencephalon. It divides into rostral and caudal branches at the edge of cerebral peduncle [2].

The trunk of SCA divides into anterior or pontine, ambient and quadrigeminal segments. Anterior segment, the proximal portion of SCA lies on the anterior surface of the pons. Ambient segment begins at the lateral border of the pons courses in ambient cistern, parallel to the course of trochlear nerve. Distal segment of SCA, the quadrigeminal segment lies within the quadrigeminal cistern [3].The territory of the SCA includes superior vermis, anterior medullary vellum, superior surface of cerebellar hemisphere, middle cerebellar peduncle, superior cerebellar peduncle, upper pons, pineal gland and part of the mid brain[4][5].

SCAs are often duplicated. The duplication may play an important role in trigeminal neuralgia if one of the branches courses caudally.The common PCA-SCA trunk may compress the oculomotor nerve and cause its palsy [1].

Aneurysms of the posterior circulation account for 15% of all intracranial aneurysms.Most common location is basilar apex followed by the site of origin of SCA [6].The proximal SCA is an important bypass site for revascularisation surgeries.

Hence the study of variations in the origin of SCA and the dimensions of its proximal segment are of immense value in analysing the angiographic images and in advanced microsurgical procedures for aneurysms and the posterior fossa lesions.

MATERIALS AND METHODS

The study was undertaken during the education dissection for undergraduate students in the department of Anatomy, K.A.P.V.Government medical college,Trichy. Totally 80 brain specimens were collected from embalmed cadavers of both sexes, of ages ranging between 40 to75 years for the period of five years.

After the removal from cranial cavity,the brain specimens were preserved in 10% formalin. The base of the brain was examined and the arachnoid mater was carefully teased to visualise the SCAs.Origin of SCA and its variations were observed.Presence of duplication or triplication were noted. The outer diameter of SCA at its origin, length of proximal segment of SCA and the distance between origin of SCA and PCA were measured using graduated Vernier calipers

(sensitivity 0.1mm aerospace) and recorded.

RESULTS

SCA was present bilaterally in all the 80 specimens (100%).160 SCAs were analysed. SCA was found to arise from basilar artery in 152 cases. SCA originated from PCA in 3 cases [Fig: 1]. It arose from a common trunk along with PCA in 5 cases.[Table: 1]

Table 1: Variation in the Origin of SCA.

Origin from	Frequency	Percentage
Basilar artery	152	95%
PCA	3	1.90%
Common trunk	5	3.10%

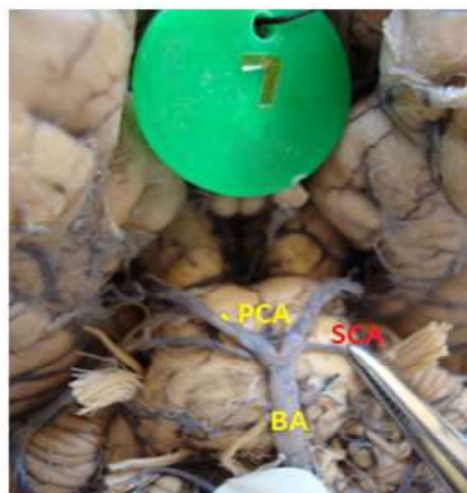
SCA arose as a single trunk in 129 cases. Duplication was present in 28 cases [Fig:2] and triplication was seen in 3 cases[Fig:3]. Duplication and triplication were present only in SCAs which arose from the Basilar artery. [Table: 2]

Table 2: Pattern of origin of SCA.

Pattern of SCA	Origin of SCA	No. of Cases	Percentage
Single vessel	From Basilar artery	121	80.60%
	From PCA	3	
	From Common trunk	5	
	TOTAL	129	
Duplication	From Basilar artery	28	17.50%
Triplication	From Basilar artery	3	1.90%

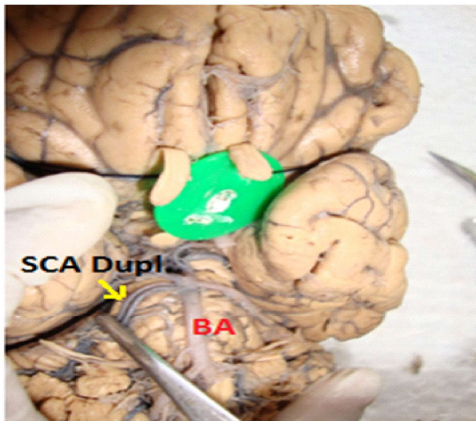
Outer diameter of SCA at its origin was measured and recorded. It was 1.8mm ± 0.5mm on the right side and 1.6mm ±0.4mm on the left side .The length of proximal segment of SCA ranged from 9mm to 24mm.The distance between SCA and PCA ranged from 0.6mm to 3.2mm.

Fig. 1: Showing the origin of SCA from PCA.



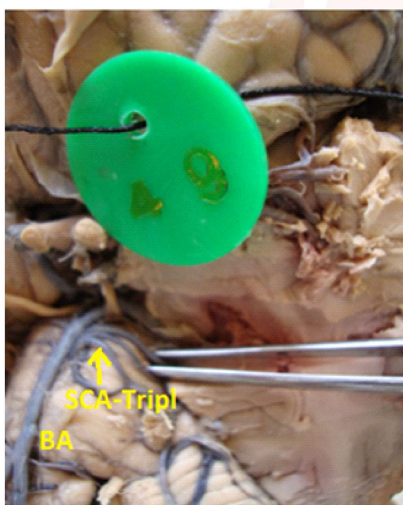
BA- Basilar artery. SCA- Superior Cerebellar artery, PCA- Posterior Cerebral artery.

Fig. 2: Duplication of SCA.



BA- Basilar artery. SCA Dupl- Superior Cerebellar artery Duplication.

Fig. 3: Triplication of SCA.



BA-Basilar artery, SCA Tripl- Superior cerebellar artery Triplication.

DISCUSSION

SCA is the most constant branch arising from the basilar artery. In this study, it was present in all the specimens. It arises typically from the distal part of basilar artery just proximal to its terminal bifurcation. Variations in its origin include origin from PCA and origin as common trunk with PCA.

Uchino et al [1] and Julius Ogeng'o et al [7] reported the origin of SCA from PCA in 4% of cases. According to Pai BS et al, it was 2% [8]. In the present study, SCA arose from PCA in 1.9% of cases.

The frequency of origin of SCA from a common trunk along with PCA was 4%, & 2.5% of cases, according to Hardy et al [9] and Julius et al [7] respectively. It was 25.3% in a study conducted by Padmavathi [10]. Songur et al [11] recorded

the common trunk variation in 6.3% of cases on the right side, 10% on the left side and 1.8% on both sides. In the present study, the rate at which SCA and PCA originated as common trunk was found to be 3.1%.

The SCA-PCA common trunk may compress the oculomotor nerve as it lies in the crux between SCA and PCA and may cause its palsy.

Duplication is the most common anomaly described in the literature with a frequency of 11% to 36%. Duplication was reported by McCullough [12], Hardy et al [9], Songur et al [11], Pai BS et al [8], and Julius Ogeng'o et al [7]. It was also reported by Mani et al [13], and Uchino et al [1] by analysing the angiographic pictures. Padmavathi [10] studied the variations of SCA and reported the duplication rate as 23.3%. [Table:3]

Table 3: Comparison of various studies on duplication of superior cerebellar artery.

Study	Right Side	Left Side	Bilateral
McCullough 1962 [12]	12%	16%	3%
Uchino et al 2003 [1]	4.40%	2.90%	2.20%
Songur et al 2008 [11]	14.50%	12.70%	7.20%
Present study	8.10%	6.90%	2.50%

According to McCullough, the triplication rate was 3%. It was 2% as reported by Mani et al and Padmavathi. In the current study, it was 2.5%.

As III, IV, V Cranial nerves are closely related to SCA, variant origin of SCA may cause neurovascular compression syndrome. One of the trunks of duplicated SCA may compress the trigeminal nerve root and may cause neuralgia. Microsurgical relationship of SCA with V cranial nerve is important not only for trigeminal neuralgia, but also in possible injury of vessels during rhizotomy and other surgeries on V cranial nerve [14].

The variant origin of SCA can be explained on the developmental basis. Basilar artery is formed by the fusion of longitudinal channels which differentiate along the ventral surface of hindbrain. This artery later connects cranially with internal carotid arteries (ICA) and caudally with vertebral arteries. Caudal division of ICAs form PCA & posterior communicating arteries [5]. Lack of normal fusion at the cranial end results in the variations of basilar bifurcation and origin of SCA. If PCA which connects carotid

Table 4: Various studies on dimensions of SCA.

Study	Length of proximal segment of SCA	Outer diameter of SCA at its origin		Distance between SCA&PCA
		right side	left side	
Songur et al (2008) [11]	-	1.28±0.46mm,	1.27±0.38mm	-
Padmavathi (2014) [10]	6mm to23 mm	2.0±0.4mm on	1.9±0.3mm	0.7 mm to 4.5mm
Present study	9mm to 24mm	1.8±0.5mm on	1.6±0.4mm	0.6mm to 3.2mm

system and primitive neural arteries fuses caudally at a lower than normal point, it leads to the variant origin of SCA from PCA [7]. One of the branches of SCA may take direct origin from basilar artery and result in duplication [15].

SCA aneurysm accounts for 1.7% of all intracranial aneurysms. SCA aneurysm is most commonly located at its origin from basilar artery [16]. For the microsurgical techniques like clipping or wrapping the aneurysm, the factors to be evaluated are diameter of the vessel, proximity of the segment and collateral blood flow. The SCA diameter is an important factor to be assessed in angiographic studies [17].

In our study we measured the outer diameter of SCA at its origin, length of its proximal segment and distance between SCA & PCA. [Table:4]

According to Prakash Nair et al [18], vascular anomalies contributed to altered dynamics of blood flow and the development of aneurysms. Being one of the frequent locations for posterior circulation aneurysm, preoperative evaluation of variations of SCA is important for planning better surgical approach and suitable operative techniques.

CONCLUSION

Anatomic study of arterial supply of brain continues to yield newer insights in the field of neuroradiology and neurosurgery. The precise knowledge of vascular anatomy of brain, combined with the use of the operating microscope, will improve the technical performance of neurosurgical techniques like aneurysm obliteration and skull base tumour removal. In this modern era of pinhole surgeries, the anatomical knowledge of the intricate details of the origin, diameter, length, duplication and triplification of the SCA will enable surgeons to accomplish complex microsurgical procedures by deploying smaller incisions, lesser brain retraction and more accurate nerve and vascular repair.

Conflicts of Interests: None

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