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Variant origin of the superior cerebellar artery in a black Kenyan population

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SUMMARY

Knowledge of variant origin of the superior cerebellar artery is important during neuroradiological and neurosurgical procedures at the basilar termination and clivus regions, and may influence the occurrence of atherosclerosis and aneurysms. These variations show ethnic differences, but there are hardly any reports on the black African population. This study therefore examined the various origins of 394 superior cerebellar arteries from 173 brains of black adult Kenyans, obtained during autopsy at the Department of Human Anatomy, University of Nairobi, Kenya. The cranial cavity was opened and the brain removed *en bloc*. Arachnoid matter was gently removed to expose the arteries at the base of the brain. The distal third of the basilar artery was exposed and superior cerebellar artery identified as that which supplied the superior surface of the cerebellar hemispheres. It was traced to its origin and the source recorded. Representative patterns were photographed with a high resolution digital camera. The data were analyzed for frequency and are presented in macrographs and a table. The conventional single artery origin from the basilar artery was present in only 284 (72.1%) cases. In the remainder, it was duplicated in 84 (21.3%), originated from posterior cerebral artery in 16 (4.0%) and from common trunk with posterior cerebral artery in 10 (2.5%) cases. Variant origin of the superior cerebellar artery occurred in nearly 28% of cases studied. This influences the pattern of termination of the basilar artery, may complicate posterior cranial fossa surgery and predispose to atherosclerosis and aneurysms. Preoperative evaluation of the superior cerebellar artery is recommended.

Key words: Superior cerebellar artery – Kenyans

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INTRODUCTION

The superior cerebellar artery (SCA) usually arises from the basilar artery, courses posteriorly around the midbrain to supply the superior surface of cerebellar hemispheres and superior vermis (Mani, 1968). Knowledge of its variant origin is valuable to neuroradiologists and neurosurgeons in improving understanding vascular malformations, SCA syndrome, handling of lesions of the basilar termination, explaining trigeminal neuralgia and variant termination of the basilar artery (Arifoglu et al., 2002; Padmavathi et al., 2011; Aydin et al., 2011; Ogeng'o et al., 2012). It is also important in order to avoid inadvertent ligation or sectioning of the arteries during surgical approaches to the posterior cranial fossa for aneurysms, arteriovenous malformations, tumors, epilepsy surgery, posterior temporal lobectomies and posterior cerebral revascularization (Uchino et al., 2003; Pai et al., 2007; Zador et al., 2010).

The variant origin is pertinent during diagnostic and interventional neuroradiology in avoiding incorrect diagnosis, explaining unusual presentation of posterior circulatory stroke, possible implications of surgery and interventional procedures (Bulsara et al., 2007; Bykowski et al., 2011). The different patterns may influence the occurrence of aneurysms, atherosclerosis and posterior circulatory

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stroke (Songur et al., 2008). These conditions are common. For example, posterior cranial fossa tumors constitute 54-70% of childhood and 15-20% of adult brain tumors (Rehman et al., 2009). Posterior circulatory stroke on the other hand accounts for 10-15% of all strokes (Kora et al., 2011). The SCA variants show ethnic differences (Mandiola et al., 1997). Data from black populations are, however, scanty and altogether absent for the Kenyan one. This study, therefore, investigated the origin of SCA in a black Kenyan population.

MATERIALS AND METHODS

Materials for this study were three hundred and ninety four (394) SCA from 173 brains of black adult Kenyans (99 male, 74 female). The brains were obtained during autopsy at Department of Human Anatomy, University of Nairobi, Kenya. The cranial cavity was opened and the brain removed *en bloc*. Arachnoid was gently peeled off the base of brain, and the basilar artery followed to its bifurcation into the terminal branches which were identified as posterior cerebral arteries (PCA). The superior cerebellar artery was identified as that which ramified over the superior surface of the cerebellar hemispheres. Arteries were defined as common trunks if their branches were of almost equal diameter on macroscopic examination. Where one branch was smaller, the larger one was considered the parent. Each of these arteries was followed distally to ascertain their destination and distribution. Their site and pattern of origin were then recorded. Photographs of representative patterns were taken using a high resolution digital camera. The data were analyzed for frequencies in case of individual arteries.

Table 1. Pattern of origin of SCA among black Kenyans. PCA, posterior cerebral artery.

Origin	Pattern	Frequency (%)
Basilar artery	Single	284 (72.1)
	Duplicated	84 (21.3)
Posterior Cerebral Artery	Single	08 (02.0)
	Duplicated	08 (02.0)
Common trunk with PCA	Single	06 (01.5)
	Duplicated	04 (01.0)
Total		**394 (100)**

RESULTS

The superior cerebellar artery (SCA) arose directly from the basilar in 368 (93.4%) cases. Among these ones 284 (72.1%) were single (Fig. 1A), while 84 (21.3%) were duplicated (Fig. 1B). In 8 (2.0%) cases, the duplication was bilateral (Fig. 1C) while in 76 (12.3%) it was unilateral. It arose as common trunk with PCA in 10 (2.5%) cases (Fig. 1D). Of the cases of common trunk with PCA, the SCA was duplicated in four (1.0%) cases. It arose from posterior cerebral artery in 16 (4.0%) cases. In eight of these cases (2%) of origin from the PCA it was duplicated. These various patterns are summarized in Table 1. In all the cases, the superior cerebellar arteries, irrespective of their mode of origin, ramified over and supplied the superior surface of the cerebellum.

DISCUSSION

The topography of superior cerebellar artery and its branches is important during surgical approaches to the basilar apex, tentorial incisura, the trigeminal nerve, CP angle, the pineal region, the clivus and the upper part of cerebellum (Hardy, 1980). Presence of variations can alter the plan of surgical and radiological procedures. Knowledge of such variations and anomalies along with clinical manifestations is critical for neurosurgeons and neuroradiologists (Padmavathi, 2014). In the current study, the SCA arose from the basilar artery as a single trunk in 72.1% of cases. This is within the range of 49-96% reported in literature (Table 2).

The studies cited in table 2 reveal, at variance with most literature reports, that SCA is the most consistent of the infratentorial arteries in terms of origin (Dagcinar et al., 2007; Isolan et al., 2012), that it may be conventional in less than 50% of the cases. (Padmavathi, 2014). Several types of variations may be due to absence of fusion of the primitive neural arteries at the rostral limit of the basilar artery during early embryonic stage (Uchino et al., 2003). This implies that due caution should be taken when performing procedures involving this artery. These variations should also be borne in mind when interpreting intracranial images and

Table 2. Mode of origin of superior cerebellar artery in literature.

Author	Pattern of origin of **superior cerebellar artery** (%)			
	Single trunk from basilar artery	Duplication from basilar artery	Triplication from basilar artery	From posterior cerebral artery
Mani, 1968	62	36.0	2.0	2.0
Pai et al., 2007	96	-	-	4.0
Padmavathi, 2014	49.4	23.3	2	25.3
Hardy, 1980	86	14.0	-	
Uchino et al., 2003	84.2	11.0		4.8
Current study	72.1	21.3	-	4.0

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signs of stroke.

The observations in the current study reveal overall duplication rate of 24.3%, within the range of 11-36% reported in literature (Hardy et al., 1980; Avci et al., 2001) (Table 2). Duplication has been attributed to direct origin of branches of SCA such as the marginal artery from BA (Dagcinar et al., 2007). A remarkable finding of the current study is the high frequency of the bilateral duplication of SCA. The literature is relatively silent on this variation. This variant anatomy is important in several respects. First, in case of duplication, the additional artery may sustain circulation in case of thromboembolic occlusion of one. A pertinent observation of the current study in support of this suggestion is that in all cases the SCA, in spite of variant origin, supplied the superior surface of the cerebellum. Secondly, a proximal origin of some of these arteries may confer on them perforators which must be safeguarded during cerebellopontine angle and clivus surgery (Dagcinar et al., 2007). Thirdly, a laterally deviated common SCA/PCA trunk may compress the occulomotor and / or trigeminal nerves (Uchino et al., 2003). Finally, preoperative identification of SCA variations is important for avoiding complications during surgery and/or interventional procedures of the distal basilar artery (Uchino et al., 2003).

The origin of SCA from PCA is not common, usually documented only as case reports. The frequency of 4.0 is within 2.0-4.8% the reported in prevailing literature (Table 2). The recent report of over 25% by Padmavathi (2014) suggests that variation may be much more frequent than currently envispased. It is probably due to lack of normal fusion of BA at the origin of SCA during development of BA from primitive neural arteries. Consequently, the PCA which connects the carotid sys-

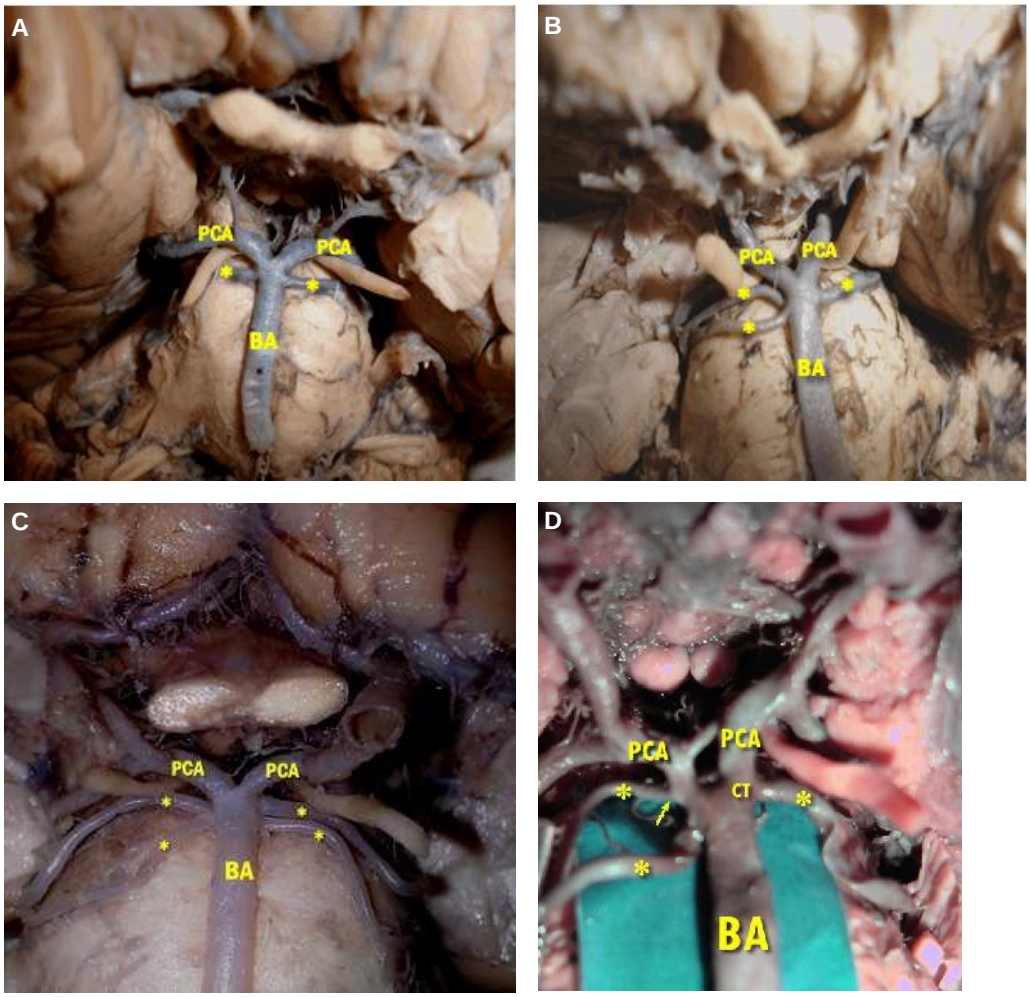

Fig. 1. (A) Bilateral single superior cerebellar artery (asterisks) arising from basilar artery (BA), immediately caudal to posterior cerebral artery (PCA). **(B)** Unilateral duplication of right superior cerebellar artery (asterisks), arising from basilar artery (BA), caudal to posterior cerebral artery (PCA). Note the single left superior cerebellar artery. **(C)** Bilateral duplication of superior cerebellar artery (asterisks), arising from basilar artery (BA), caudal to posterior cerebral artery (PCA). **(D)** Superior cerebellar artery (asterisk) arising from common trunk (CT) with posterior cerebral artery (PCA) on the left side. Note the duplication of SCA on the right side with one of the SCA arising from the PCA (arrow). BA, basilar artery.

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tem and primitive neural arteries anastamose with BA caudally at a point lower than the normal site. It is important knowledge to minimize misinterpretations and of CT and MRI scans and surgical risk (Aydin et al., 2011)

A common trunk with PCA, observed at 2.5%, is within the range of 2-22% reported in literature (Hardy, 1980; Okahara et al., 2002; Padmavathi et al., 2011). It arises from unusual development of distal basilar region during embryogenesis. Anticipation of this variation is important during neuroradiology, cerebrovascular surgery and interpretation of posterior circulatory stroke (Bala, 2013).

Conclusion

Variant origin of SCA occurs in nearly 28% of individuals studied. This influences the pattern of termination of basilar artery, may complicate surgery at the clivus and basilar termination and predispose to atherosclerosis and aneurysms. Preoperative evaluation of superior cerebellar artery is recommended.

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