# Topography of The Posterior Communicating Artery in a Kenyan Population

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## Abstract

**Background**
Configuration and branching pattern of the posterior communicating artery influence occurrence and approaches to management of aneurysms. Distribution of the various configurations and branching patterns shows population variations but reports from Africa are scanty.

**Objective**
To determine the prevalence of various configurations and branching pattern of the posterior communication artery in a Kenyan population.

**Materials and Methods**
Eighty four posterior communicating arteries obtained from Department of Human Anatomy were studied. The configuration and number of branches in each third and length of the longest perforator free zone of the posterior communicating artery were evaluated

**Results**
Adult configuration was observed in 56%, hypoplastic in 25%, fetal in 12% and transitional in 7%. Mean number of branches given off was 7.2 ± 1.9 (range: 3-12), highest in proximal and lowest in the distal third of the artery. Perforator free zone ranged between 1mm to 8mm with a mean of 4.01 ± 1.54mm and was longest in the hypoplastic configuration.

**Conclusion**
Configurations observed in the Kenyan population are comparable to those reported in the Caucasian populations. From an anatomical standpoint, the two are equally predisposed to development of aneurysms. Posterior third of PComA had the least number of branches suggesting that the pterional approach to basilar tip aneurysm among Kenyans may be a safer procedure.

## Introduction

Configuration of posterior communicating artery (PComA) influences occurrence of aneurysm (1). Knowledge of branching pattern on the other hand, is important during division of PComA for large aneurysms (2) and in pterional approach to aneurysms of basillar artery bifurcation and PComA (3). Both configuration and branching pattern show ethic differences (4,5). These variations may explain local prevalence of PComA aneurysms (6) as well as influence their surgical management. Among African populations these parameters are however only scantily reported. This study therefore investigated the configurations and branching pattern of PComA in a black Kenyan population.

## Material and methods

Eighty four PComA specimens of black Kenyans (27males, 15females) were obtained during autopsy and routine dissection at the Department of Human Anatomy, University of Nairobi. Ethical approval was obtained from the Kenyatta National Hospital Ethics and Research committee. Following craniotomy, the brains were transected at the medulla oblongata, dural folds and cranial nerves sectioned, and the brain extracted as a whole. Meninges were peeled off at the base of brain and temporal lobe displaced outwardly to expose the circle of Willis. PComA was identified and the type of configuration recorded and photographed.

The arteries were classified into four configurations namely adult, transitional, fetal and hypoplastic as previously described (7,8).

In the adult configuration, the PComA has smaller diameter than the P1 segment of the Posterior Cerebral Artery. PComA with an external diameter of less than 1mm is considered hypoplastic.

The fetal configuration results from failure of the PComA to regress, P1 segment often remains hypoplastic and the Internal Carotid Artery supplies the PCA. The PComA meanwhile has a similar diameter with the P1 segment of the PCA in the transitional configuration. By use of dissecting lenses (magnification X10) the number of branches in each third of the artery was recorded and photographs taken using a digital camera (Olympus® 9.0 Megapixels).

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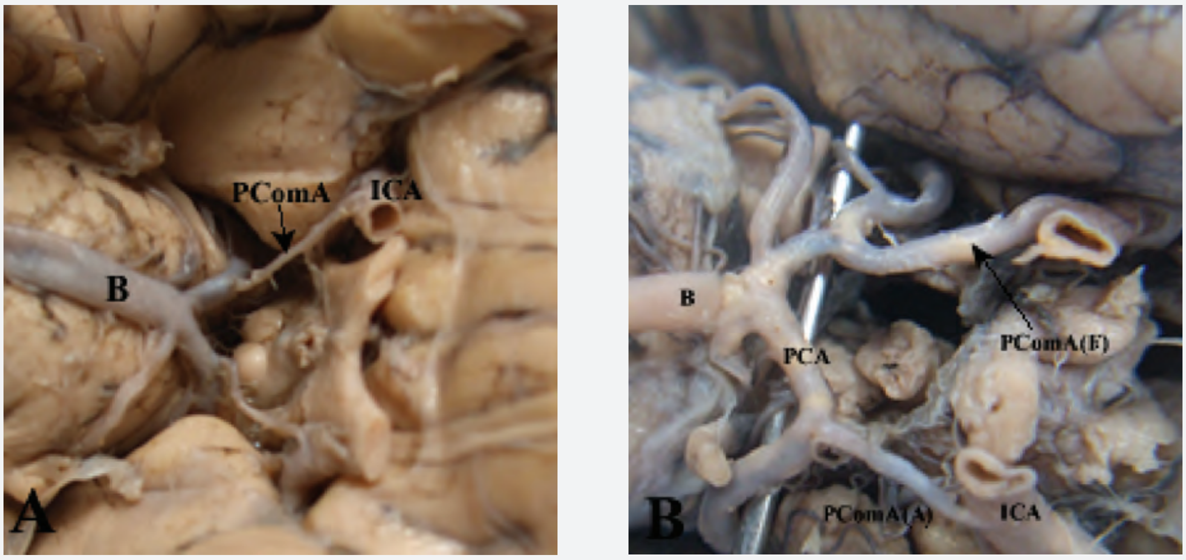
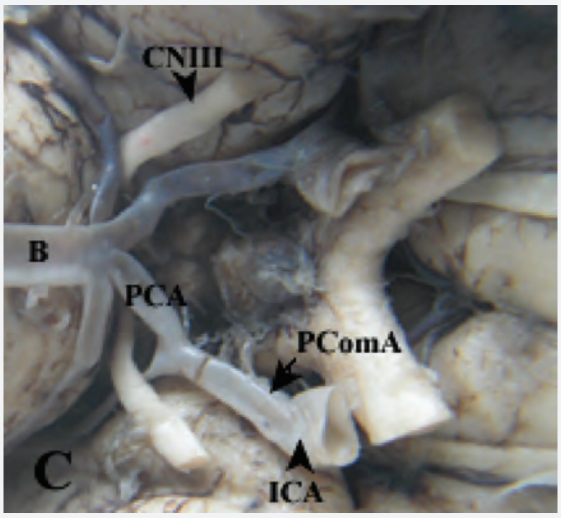



*Figure 1: Macrograph of the circle of Willis showing configurations of the posterior communicating artery.*

***Note: B=** Basillar artery **ICA=** Internal Carotid Artery. **PCA=** Posterior Cerebral artery. **CN III=** 3rd cranial nerve.*
***A** - Hypoplastic configuration.*
***C**- Transitional configuration*
***B**- Co-existence of Adult [(PComA (A)] and fetal [PComA (F)] configuration.*




## Results

All the 84 PComA examined originated from the second part of internal carotid artery (ICA) and ran posteriorly in the interpeduncular fossa to join the posterior cerebral artery (PCA).

### Type / Configuration

The most common PComA configuration was adult (56%) observed in 47 cases.Other configurations encountered included hypoplastic in 21 (25%), fetal in 10 (12%) while the transitional configuration was observed in 6 (7%). [Figure 1]

### Branching pattern of the PComA

Branches given off by the PComA ranged from 3 to 12 (7.15 ± 1.92) and were distributed in the various configurations as shown (Table 1). When analyzed for each third of the artery, mean number of branches was highest in proximal and lowest in the distal third. In fetal configuration however, the middle segment had the highest number of branches (Table 1).

In majority of PComA, the longest perforator free zone was located in the distal third of the artery while in 25% of the specimens it was located in the middle third. Mean length of the perforator free zone was 4.01 ± 1.54mm. Although the hypoplastic and the transitional configurations displayed the longest and shortest perforator free zone (4.28 ±1.42and 3.50 ± 2.09mm respectively) no association with type was noted (p= 0.058).

# Discussion

## Types/Configuration

In the present study, adult configuration was the most prevalent (56%). This is higher than figures reported from Turkish, Bulgarian and Jordanian populations but lower than the Sri Lankan populations (Table 2). When adult and hypoplastic were clustered together, it was higher than that in Turkey, lower than Sri Lanka but comparable to Bulgaria and Jordan. These results reveal significant variability in the prevalence of the adult configuration between various populations studied.

Risk of aneurysm formation is reported to be higher in the fetal, transition and hypoplastic configurations (1). Predisposition to aneurysms on this basis among Kenyans is therefore higher than that of other populations such as Turkish, Bulgarians and Jordanians but lower than reported in Sri Lankans and the Dutch. Accordingly, observations of the current study support reports that prevalence of PComA aneurysm displays ethnic variation.

Large diameter PComA especially adult, fetal or transitional configurations may easily allow dislodged thrombotic material from atherosclerotic lesion in the ICA to reach the posterior territory circulation (9). In such a case the interpretation of clinical signs and symptoms may be confusing to a clinician who expects symptoms related to the anterior territory circulation. On the other hand, hypoplastic configuration, observed in 25% of the specimens in the current study, is associated with infarction in the areas fed by its perforators following obstruction of the PComA (10,11).

Fetal configuration of PComA shows important variations from the other configurations. PComA usually runs medial to oculomotor nerve which is used as a landmark during operations (12). The fetal configuration however, unlike other configurations, is reported to course superolateral to the nerve (13,14). In the current study however PComA was medial to the nerve in all configurations. Awareness of this variability of PComA in relation to the oculomotor nerve is therefore an important consideration during operations of the base of brain especially with fetal variety of PComA. Further, the fetal configuration with an extreme lateral course of the supraclinoidal ICA may obscure exposure of the proximal neck of aneurysm involving the PComA during surgery necessitating removal of the anterior clinoid process (15).

| Type (n) | Mean no. branches | Proximal | Middle | Distal | Mean PFZ |
|---|---|---|---|---|---|
| Adult (47) | 7.0 ± 2.02 | 3.38 | 2.55 | 1.11 | 3.97 ± 1.51 |
| Transitional (6) | 6.5 ± 2.07 | 2.50 | 2.33 | 1.67 | 3.50 ± 1.37 |
| Fetal (10) | 7.5 ± 1.27 | 2.90 | 4.10 | 0.90 | 3.90 ± 2.09 |
| Hypoplastic (21) | 7.52 ± 1.94 | 3.10 | 3.05 | 1.33 | 4.28 ± 1.42 |

* *PFZ= perforator free zone*

*Table 1: Distribution of the perforator branches in the various PComA configurations.*

| Author | Population | N | Type | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | *Adult* | | |
| | | | *Adult* | *Hypoplastic* | *& Hypoplastic* | *Transitional* | *Fetal* |
| Gabrosky, 2002 | Bulgarian | 35 | 41.43% | 47.14% | 88.57% | - | 11.43% |
| Al Hussain et al., 2001 | Jordanian | 50 | 44% | 33% | 77% | 8% | 15% |
| De Silva et al., 2009 | Sri Lanka | 225 | - | - | 93.3% | 2.2% | 4.4% |
| Present study | Kenyan | 84 | **56%** | **25%** | **81%** | **7%** | **12%** |

*Table 2: Population comparisons of the PComA configurations*

| Author | Population | Mean no. of branches | Range |
|---|---|---|---|
| Acvi et al., 2004 | Turkish | 8 | 4 – 15 |
| Gabrosky, 2002 | Bulgarian | 8.17 | - |
| Uz et al., 2004 | Turkish | 5.8 | 4 -9 |
| Beumer et al., 2009 | Dutch | 5.53 | 1 – 9 |
| Present study, 2010 | Kenyan | 4.01 | 1 – 8 |

*Table 3: Distribution of the perforator branches in the various PComA configurations.*

## Branching pattern

In the present study the range and mean number of perforator branches, 3-12mm and 7.15 ± 1.92mm respectively, agrees with that reported by Gabrosky et al. (16) and Uz &Erbil (12) (Table 3). Using the pterional approach for treatment of basilar bifurcation aneurysms,

sometimes the PComA impedes visibility and hinders manipulation in the operative field (17). For this reason its division may become necessary particularly in cases of large aneurysms (2), short PComA or atherosclerotic ICA (18). The safety of such PComA division is related to preservation of its perforator vessels and therefore avoiding cerebral infarction (2, 19).
Similar to other populations (16 ,18), the perforator free zone ranged between 1 to 8mm (4.01 ± 1.54mm), more in the distal third. Division of the PComA would be safer if undertaken in this perforator free zone. Extra caution however needs to be taken as the longest perforator free zone can sometimes be in the middle third of the artery and division of the PCoA at its distal third therefore may be associated with the risk of perforator infarction.

## Conclusion

Configurations observed in the Kenyan population are comparable to those reported in the Caucasian populations. From an anatomical standpoint, the two are equally predisposed to development of aneurysms. Posterior third of PComA had the least number of branches suggesting that the pterional approach to basilar tip aneurysm among Kenyans may be a safe approach.

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