

Position and Blood Supply of the Carotid Body in a Kenyan Population

Posición y Suministro Sanguíneo del Cuerpo Carotídeo en una Población de Kenia

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SUMMARY: Position and source of blood supply to the human carotid body displays population variations. These data are important during surgical procedures and diagnostic imaging in the neck but are only scarcely reported and altogether missing for the Kenyan population. The aim of this study was to describe the position and blood supply of the carotid body in a Kenyan population. A descriptive cross-sectional study at the Department of Human Anatomy, University of Nairobi, was designed. 136 common carotid arteries and their bifurcations were exposed by gross dissection. The carotid body was identified as a small oval structure embedded in the blood vessel adventitia. Position and source of blood supply were photographed. Data are presented by tables and macrographs. 138 carotid bodies were identified. Commonest position was carotid bifurcation (75.4%) followed by external carotid artery (10.2%), internal carotid artery (7.2%) and ascending pharyngeal artery (7.2%). Sources of arterial blood supply included the carotid bifurcation (51.4%), ascending pharyngeal (21.0%), external carotid (17.4%) and internal carotid (10.2%) arteries. Position and blood supply of the carotid body in the Kenyan population displays a different profile of variations from those described in other populations. Neck surgeons should be aware of these to avoid inadvertent injury.

KEY WORDS: Carotid body; Position; Variations; Kenyan.

INTRODUCTION

The human carotid body (HCB) is usually located at the common carotid artery bifurcation (Sarrat-Torres *et al.*, 2006). Variant positions include the external carotid (Ec), ascending pharyngeal (Ap) or internal carotid (Ic) arteries (Khan *et al.*, 1988; Dymecka *et al.*, 2006). These variations are important during the assessment of neck swellings (Lam *et al.*, 1996) or in harvesting of carotid body cell aggregates for auto transplants as in treatment of Parkinsonism (Mínguez-Castellanos *et al.*, 2007).

Arterial blood supply to the organ derives from glomic arteries which usually arise from the carotid bifurcation (Heath, 1989). Other sources include the thyrocervical trunk, vertebral, Ic, Ec or Ap arteries (Sarrat-Torres *et al.*; Ozay *et al.*, 2008). Failure to recognize these abnormal sources may lead to inadequate haemostasis during carotid tumor resection (Ozay *et al.*). The incidence of variations in position and blood supply varies between populations (Khan *et al.*) and despite their clinical

significance, data from African populations is scarce and altogether absent for the Kenyan population.

This study therefore investigated the position and blood supply of the carotid body in a Kenyan population

MATERIAL AND METHOD

One hundred and thirty-six (136) carotid blocks were studied by gross dissection at the Department of Human Anatomy, University of Nairobi. Ethical approval was granted by the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee.

Carotid arteries were exposed by placing the head of the cadaver in hyperextension and making an incision along medial border of sternocleidomastoid muscle (SCM) from

base of mastoid process to medial end of the clavicle. Skin was reflected and SCM retracted laterally to reveal the carotid sheath. The carotid bifurcation was exposed by blunt dissection. The carotid body was identified as a small oval structure embedded in the blood vessel adventitia. When the HCB was not located at the bifurcation its position was defined as variant.

Position and source of blood supply to the carotid body were recorded on data sheets and representative macrographs taken using a digital camera (Sony Cybershot R, W200, 7.2 Megapixels). Data were presented using macrographs and tables.

RESULTS

One hundred and thirty-eight (138) carotid bodies were identified. Of these, 104 (75.4%) were located on the posterior surface of the carotid bifurcation. Other positions observed were on the External carotid (10.2%), Internal carotid (7.2%) and Ascending pharyngeal (7.2%) arteries (Fig. 1 A-E). There was bilateral asymmetry in 12 individuals (17.7%). In one specimen there were three carotid bodies, two at the bifurcation and one on the internal carotid artery (Fig. 1E).

Arterial blood supply was sourced from the carotid bifurcation in 71 (51.4%) of the specimens. Variations from this pattern are shown in Table I.

Table I. Variations in source of arterial blood supply to the carotid body.

| Source of arterial supply to carotid body | Cases (%) |
|---|-----------|
| Bifurcation | 51.4 |
| Ascending Pharyngeal | 21.0 |
| External carotid | 17.4 |
| Internal carotid | 10.2 |

DISCUSSION

Position of the carotid body varies (Khan *et al.*) with the commonest position being at the carotid bifurcation (Heath; Sarrat-Torres *et al.*). Observations of the current study are therefore concordant though proportions of variant positions vary between populations (Table II). These variations are important in diagnostic imaging during the assessment of neck swellings (Lam *et al.*; Sarrat-Torres *et al.*). In clinical practice, early identification of space occupying lesions in the carotid body is required for successful intervention. Surgical procedures are also safer as there is minimal invasion of surrounding neurovascular structures (Lam *et al.*).

Table II. Position of the carotid body (%) in Kenyan and British populations.

| Position of the carotid body | Kenyan population % (n=138) Present study | British population % (n=200) Khan <i>et al.</i> , 1988. |
|------------------------------|---|---|
| Carotid | 75.4 | 86.5 |
| External carotid | 10.2 | 8.0 |
| Internal carotid | 7.2 | 3.5 |
| Ascending | 7.2 | 2.0 |

Further, the variant positions pose a challenge to the clinician trying to identify the nature of any neck swelling since chemodectoma may be mistaken for many other lesions in the cervical region (Arslan *et al.*, 2000). Clinicians in the Kenyan population therefore need to be aware of the variations in position of the HCB.

Blood supply to the carotid body. The HCB usually derives arterial blood from carotid bifurcation, internal carotid, external carotid or ascending pharyngeal arteries (Heath; Sarrat-Torres *et al.*, 2006). Observations of the current study support literature reports that common carotid and external carotid arteries are the commonest sources of blood supply to the carotid body (Heath & Edwards, 1971; Jago *et al.*, 1982). However, here are population differences in supply as derived from these arteries (Table III).

Table III. Variations of the source of glomic artery in the Kenyan and British populations.

| Source of glomic artery | Kenyan population % (n=138) Present study | British population % (n=150) Lowe <i>et al.</i> , 1987. |
|-------------------------|---|---|
| Bifurcation | 51.4 | 88 |
| Ascending | 21.0 | 2 |
| External | 17.4 | 5 |
| Internal | 10.2 | 5 |

Source of blood supply to the carotid body is highly variable in the Kenyan population. Whereas in the British population blood supply was mostly sourced from the carotid bifurcation (88%), in the Kenyan population, the ascending pharyngeal, external carotid and internal carotid arteries are major sources together accounting for 49.6% whereas they account for 12% in the British population.

Other studies have focused on animals and observations reveal a highly variable pattern of arterial blood supply to the carotid body in different species. This lack of uniformity of the vascular pattern seems to be related to the degree of variation in the arrangements of the common carotid bifurcation (Chungcharoen *et al.*, 1952).

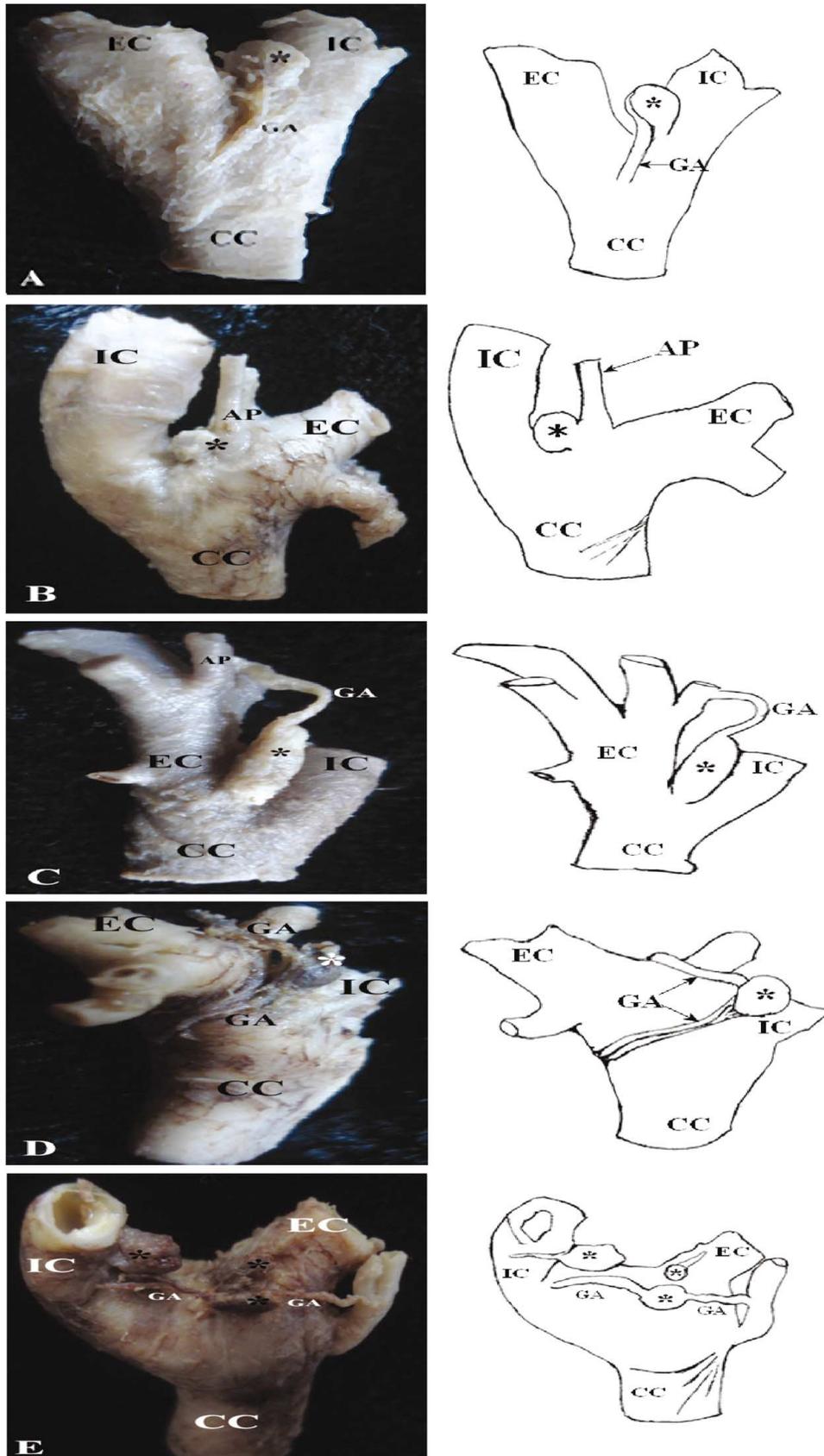


Fig 1. Macrographs of bifurcation area of common carotid and its branches showing different positions of the carotid body and origin of corresponding glomic arteries. A) Carotid body (black asterix) located at the bifurcation of the common carotid artery (CC). Glomic artery (GA) arising from the bifurcation. B) Carotid body (black asterix) located at the base of the ascending pharyngeal artery (AP). Blood supply was from the same vessel. C) Carotid body (black asterix) located at the bifurcation of the CC. Glomic artery (GA) arising from the ascending pharyngeal artery (AP). D) Carotid body (white asterix) located at the base of the external carotid artery (EC). Supplied by two glomic arteries (GA) from the same vessel. E) Specimen with three carotid bodies (black asterixes) located at different positions. Glomic arteries (GA) from internal and external carotid arteries.

Information on the sources of blood supply to the HCB helps in exposure and haemostasis during carotid tumor resection (Ozay *et al.*). Due to the higher variability found in this population surgeons may find it prudent in the preoperative work up to indicate the likely variations in the sources of blood supply to the carotid body so as to avoid unnecessary hemorrhage during surgery.

In conclusion position and blood supply of the carotid body in the Kenyan population displays a different

profile of variations from those described in other populations. Neck surgeons should be aware of these to avoid inadvertent injury.

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MUTHOKA, J. M.; HASSANALI, J.; MANDELA, P.; OGENG'O, J. A. & MALEK, A. A. Posición y suministro sanguíneo del cuerpo carotídeo en una población de Kenia. *Int. J. Morphol.*, 29(1):65-68, 2011.

RESUMEN: La posición y la fuente de suministro sanguíneo del cuerpo carotídeo humano muestra variaciones en la población. Estos datos son importantes durante los procedimientos quirúrgicos y de diagnóstico por imagen en el cuello, pero son poco informados e inclusive faltan por completo en la población de Kenia. El objetivo de este estudio fue describir la posición y el aporte sanguíneo del cuerpo carotídeo en una población de Kenia. Se diseñó un estudio descriptivo de corte transversal en el Departamento de Anatomía Humana de la Universidad de Nairobi. 136 arterias carótidas comunes y sus bifurcaciones fueron expuestas mediante disección simple. El cuerpo carotídeo fue identificado como una pequeña estructura oval ubicada en la adventicia del vaso sanguíneo. La posición y la fuente de suministro sanguíneo fueron fotografiados. Los datos obtenidos fueron presentados en las tablas y fotomicrografías. 138 cuerpos carotídeos fueron identificados. La posición más frecuente fue la bifurcación carotídea (75,4%), seguida de la arteria carótida externa (10,2%), arteria carótida interna (7,2%) y la arteria faríngea ascendente (7,2%). Las fuentes de suministro sanguíneo arterial incluyeron la bifurcación carotídea (51,4%), arteria faríngea ascendente (21,0%), arteria carótida externa (17,4%) y arterias carótidas internas (10,2%). La posición y el suministro sanguíneo del cuerpo carotídeo en la población de Kenia muestra un perfil de variaciones diferente a las descritas en otras poblaciones. Los cirujanos de cuello deben conocer estas variaciones para así evitar lesiones accidentales.

PALABRAS CLAVE: Cuerpo carotídeo; Posición; Variaciones; Kenia.

REFERENCES

- Arslan, H.; Unal, O.; Kutluhan, A. & Sakarya, M. E. Power Doppler scanning in the diagnosis of carotid body tumors. *J. Ultrasound Med.*, 19:367-70, 2000.
- Chungcharoen, D.; De Burgh Daly, M. & Schweitzer, A. The blood supply of the carotid body in Cats, Dogs and Rabbits. *J. Physiol.*, 117:347-58, 1952.
- Dymecka, A.; Walski, M. & Pokorski, M. Ultrastructural degradation of the carotid body in the aged rat: is there a role for atherosclerosis in the main carotid arteries? *J. Physiol. Pharmacol.*, 57:85-90, 2006.
- Heath, D. View from beneath—Pathology in Focus. A new look at the carotid bodies. *J. Laryngol. Otol.*, 103:803-5, 1989.
- Heath, D. & Edwards, C. The glomic arteries. *Cardiovasc. Res.*, 5:303-12, 1971.
- Jago, R.; Heath, D. & Smith, P. Structure of the glomic arteries. *J. Pathol.*, 138:205-18, 1982.
- Khan, Q.; Heath, D. & Smith, P. Anatomical variations in human carotid bodies. *J. Clin. Pathol.*, 41:1196-9, 1988.
- Lam, P. W.; Peh, W. C. & Wei, W. I. Clinics in diagnostic imaging (15). Carotid body tumour. *Singapore Med. J.*, 37:430-2, 1996.
- Lowe, P.; Heath, D. & Smith P. Relation between histological age-changes in the carotid body and atherosclerosis in the carotid arteries. *J. Laryngol. Otol.*, 101:1271-5, 1987.
- Mínguez-Castellanos, A.; Escamilla-Sevilla, F.; Hotton, G. R.; Toledo-Aral, J. J.; Ortega-Moreno, A.; Méndez-Ferrer, S., et al. Carotid body autotransplantation in Parkinson disease: a clinical and positron emission tomography study. *J. Neurol. Neurosurg. Psychiatry*, 78:825-31, 2007.
- Ozay, B.; Kurc, E.; Orhan, G.; Yucel, O.; Senay, S.; Tasdemir, M.; Gorur, A. & Aka, S. A. Surgery of carotid body tumour: 14 cases in 7 years. *Acta Chir. Belg.*, 108:107-11, 2008.
- Sarrat-Torres, M. A.; Torres, A.; Whyte, J.; Baena, S.; Cisneros, A. & Sarrat, R. Structure, location, function and pathological features of the human carotid body. *Eur. J. Anat.*, 10:1-5, 2006.

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