Original Article

RELATIONSHIP OF EXTERNAL CAROTID ARTERY WITH REFERENCE TO ADJACENT ANATOMICAL LANDMARK: A CADAVERIC STUDY

Dr. Danish Anwer[1], Dr. Hamid Ansari[2], Dr. Abuzar Abdalla[3]

[1]Assistant Professor, Department of Anatomy, Faculty of Medicine, Jazan University, Jazan, Saudi Arabia.
[2]Associate Professor, Department of Anatomy, RMCRC, Rama University, Kanpur, UP, India.
[3]Lecturer, Department of Anatomy, Faculty of Medicine, Jazan University, Jazan, Saudi Arabia.
Corresponding Author: Dr. Hamid Ansari

DOI: 10.47750/pnr.2022.13.S06.522
Received: 20 October 2022, Accepted: 28 November 2022, Published: 12 December 2022

Abstract

Background & Aim: Anyone practising surgery or medicine should have a firm grasp on the regular anatomy of ECA and its variants, as well as its branches. Both carotid endarterectomy and carotid stenting, which are used to prevent recurrent strokes, necessitate in-depth familiarity with the carotid system. The aim of the present study was to study the relationship of External Carotid Artery with reference to Adjacent Anatomical landmarks in cadavers.

Methods: The present prospective study was done in the Department of Anatomy, RMCRC, Rama University, Kanpur, UP, India, over a period of 1.5 years after obtaining clearance from the institutional ethical clearance committee. 30 hemi-necks obtained from 15 formalin embalmed cadavers (10 male and 5 female) were dissected and the external carotid arteries were traced from the origin to termination.

Results: The ECA took origin at the level of upper border of thyroid cartilage (TC) in 20/30 cases (66.66%). Higher level of origin was noted in the remaining 10 of 30 cases (33.34%). Higher levels of carotid bifurcation were further categorized keeping the TC as anatomical landmark. No lower levels of origin were noted in this study. The anteromedial position of the ECA relative to the ICA at the level of the carotid bifurcation was noted in all the cases.

Conclusion: The anatomical knowledge of relationship of External Carotid Artery with reference to adjacent anatomical landmarks is helpful for vascular surgeons to plan surgeries and prevent complications during various diagnostic and therapeutic procedures.

Keywords: Anatomical landmarks, Angle of the mandible, Cadavers, Carotid tubercle, External carotid artery

INTRODUCTION:

The carotid system begins with the common carotid artery (CCA), which branches off to form the external carotid artery (ECA) and the internal carotid artery (ICA) (ICA).[1] Unfortunately, the level of the carotid bifurcation is not indicated by any reliably observable clinical sign. The superior edge of the thyroid cartilage is where the common carotid artery is said to divide, according to most sources.[2]

The external carotid artery (ECA) and its branches are the major blood vessels in the head and neck region. It is in the carotid triangle that the common carotid artery (CCA) divides into the external carotid artery (ECA) and the internal carotid artery (ICA) (ICA). The ECA distributes blood and nutrients to the head and neck via its eight branches: the superior thyroid artery (STA), the ascending pharyngeal artery (APA), the lingual artery (LA), the

facial artery (FA), the occipital artery (OA), the posterior auricular artery (PAA), the superficial temporal artery (STA), and the maxillary artery (MA). Collateral blood flow to the brain is facilitated in large part by the multiple connections between the ECA's branches and the cranial branches of the ICA, vertebral arteries, and other blood vessels. Carotid artery injuries are the leading source of inaccessible exsanguinating haemorrhage in cases of neck trauma, requiring emergency surgical repair.[4,5] Pseudoaneurysms caused by blunt carotid damage often form in the ECA's branches rather than the main ECA itself.[6] The use of the ECA and its branches in a variety of radiological and surgical operations, including endarterectomy[7,8] carotid stenting, and different head and neck surgeries, as intra-arterial infusion chemotherapy[9,10] further supports the clinical value of the ECA and its branches.[11-13]

Anyone practising surgery or medicine should have a firm grasp on the regular anatomy of ECA and its variants, as well as its branches. Both carotid endarterectomy and carotid stenting, which are used to prevent recurrent strokes, necessitate in-depth familiarity with the carotid system.[14]

The current study's objective was to examine the connections between adjacent anatomical landmarks and the external carotid artery in cadavers.

MATERIALS AND METHODS

After receiving approval from the institutional ethical clearance committee, the current prospective study was carried out over a period of 1.5 years in the Department of Anatomy at RMCRC, Rama University, Kanpur, UP, India,

Methodology

The external carotid arteries of 30 hemi-necks taken from 15 formalin-embalmed cadavers (10 men and 5 women) were followed from their beginning to their end during dissection. This study eliminated cadavers that had undergone CCA embalming as well as those that had head and neck trauma.

The cadavers ranged in age from 50 to 80 yrs. Digital photography was used to record any variations found in the ECA's genesis and branching pattern. The data was collated, and the percentage of corpses with differences in the carotid bifurcation level and ECA branching pattern were computed and analysed.

RESULTS

Table 1: Variations in the level of bifurcation of common carotid artery

Level of origin	**No. (%)**	**Laterality (N=30)**	
		Unilateral	**Bilateral**
Normal	20 (66.66%)	0	20
High (2a)	5 (16.66%)	0	5
High (2b)	4 (13.34%)	3	1
High (2c)	1 (3.34%)	1	0
Low	0	0	0
Total	30 (100.0%)	4	26

2a-between upper border of thyroid cartilage and greater cornua of hyoid bone;

2b-at the level of greater cornua of hyoid bone;

2c-above the level of greater cornua of hyoid bone

The ECA took origin at the level of upper border of thyroid cartilage (TC) in 20/30 cases (66.66%). Higher level of origin was noted in the remaining 10 of 30 cases (33.34%). Higher levels of carotid bifurcation were further categorized keeping the TC as anatomical landmark. No lower levels of origin were noted in this study. The anteromedial position of the ECA relative to the ICA at the level of the carotid bifurcation was noted in all the cases.

Table 2: Variations in the anterior branches of external carotid artery

Branching pattern	**No. (%)**
Separate origin	24 (80.0%)
Linguofacial trunk	5 (16.66%)
Thyrolinguofacial trunk	1 (3.34%)
Thyrolingual trunk	0 (0.0%)
Total	30 (100.0%)

The anterior branches of the ECA include the STA, LA, and FA. Out of the 40 hemi-necks studied, separate origins for the anterior branches of the ECA were observed in 24 cases (80%). The linguofacial trunk was the commonest observed variation with the thyrolinguofacial trunk (TLFT) occurring only in a single case. The TLFT was found to arise 6 mm above the carotid bifurcation and after a short length of 3 mm, divided into the STA and a common linguofacial trunk. No thyrolingual trunks were observed.

Table 3: Distribution of accessory branches of external carotid artery

Name of accessory branch	**No. (%)**
Superior laryngeal artery	2 (6.66)
Double ascending pharyngeal artery	1 (3.33)
Masseteric branch	1 (3.33)
Branch to Internal jugular vein	1 (3.33)

Accessory branches were found to arise from the ECA in 5 of 30 cases (16.67%).

DISCUSSION:

In the pathophysiology of carotid atheromatous disease and its subsequent care by carotid stenting and endarterectomy, the carotid bifurcation is a significant anatomical and surgical landmark that merits special emphasis.[15]

Al-Rafiah et al.[16] and Mompeo and Bajo[17] found that in 25% and 36.85% of instances, respectively, the highest carotid bifurcation occurred at the level of the hyoid bone, which is consistent with our data. The same authors have occasionally mentioned lower levels of bifurcation as well. In the existing literature, carotid bifurcations as low as intrathoracic bifurcations have also been recorded.[18,19]

Klippel-Feil anomaly[19] may be accompanied by a low carotid bifurcation, which could make procedures like cervical discectomy challenging.[20] It should be emphasised that higher level bifurcations are more frequent than lower ones, according to earlier studies of a similar nature. This is consistent with the current investigation, which likewise revealed no low-level bifurcations. However, a high carotid bifurcation (CB) should alert surgeons to the closeness of the superior cervical ganglion and hypoglossal nerve, as well as the potential origin of STA from the CB.[2] Whether the ECA emerges from the third aortic arch low or high determines the position of the CB.[21]

Thus, it can be inferred that there is a high degree of anatomical diversity at the level of the carotid bifurcation, and careful determination of its location is required to prevent difficulties during angiographic and surgical treatments. The current research regularly mentions the prevalence of common trunks in the branching structure of the ECA. According to literature sources, the linguofacial trunk appears to be by far the most prevalent variant with a high occurrence. In the current investigation, the linguofacial trunk was seen in 16.66% of patients.

In our investigation, a single occurrence (3.34%) of a unilateral TLFT was noted. This is consistent with earlier research conclusions that TLFTs are comparatively infrequent; Al-Rafiah et al.[16] reported the incidence to be 1.7%. Common linguofacial trunks emerging from the ECA may bring the LA or FA closer to the tonsillar fossa, raising the possibility of iatrogenic vascular injury, claim Baik et al.[22] After tonsillectomy, the linguofacial trunk is another frequent site for traumatic pseudoaneurysm.[23]

According to Mata et al.[1], the embryology of the combined trunks would be consistent with the angiogenesis theory, which contends that TLFTs are more prevalent in foetuses than in adults and that they tend to disappear in adults.[1] This theory contends that confluence of the vessels and vessels with large diameter are more common in foetuses than in adults. A high origin was discovered above LA in 66% of cases and below LA in 9% of cases when Hayashi et al.[24] looked at the origin of APA from the ECA in relation to the origin of LA. In our investigation, we discovered a significant genesis of APA at the level of the LA.

In order to successfully remove plaque and reduce postoperative problems in a surgical field devoid of blood, the branches of the ECA serve as important markers for optimal exposure and proper positioning of cross-clamps.[24] The ligation of the carotid triangle's blood vessels requires caution because if these blood vessels are not identified, it could have disastrous effects on cerebral circulation or result in haemorrhage in the ECA region.[25]

CONCLUSION:

A comprehensive anatomical understanding of the angioarchitecture can help to enhance overall procedure outcomes and prevent fatal consequences because the branching pattern of the ECA in the neck exhibits a significant level of variability. Prior angiographic evaluation to determine the level of carotid bifurcation and the carotid arterial system's branching pattern may be helpful to prevent injury to important structures like the hypoglossal nerve and minimise problematic haemorrhage during surgical exploration of the head and neck region.

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Figures

Figure 1: Distance between the site of origin of right ECA and the upper border of lamina of thyroid cartilage

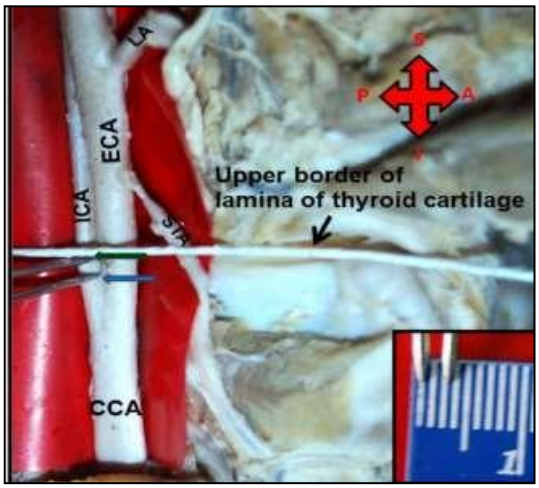

Figure 2: Site of origin of right ECA with reference to cervical vertebrae [CB(red pin) - bifurcation of CCA / origin of ECA; CT (green pin) - carotidtubercle / Chassaignac's tubercle; C1, C2, C3, C4