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Original Research Article

LEVEL OF BIFURCATION OF COMMON CAROTID ARTERY AND MORPHOMETRY OF ANTERIOR BRANCHES OF EXTERNAL CAROTID ARTERY: A DESCRIPTIVE STUDY

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ABSTRACT

Background: The common carotid artery (CCA) divides at the level of superior border of thyroid cartilage. The external carotid artery (ECA) is one of the terminal branches of CCA. ECA gives three anterior branches, Superior thyroid (STA), Lingual (LA) and Facial arteries (FA). Therefore the present study was carried out to describe the level of bifurcation of CCA, its relations with anatomical landmarks and the morphometry of anterior branches of ECA in relation to bifurcation of CCA.

Methods: The present study was carried on 30 sagittal head and neck sections. The level of bifurcation of CCA was noted. The distances from CCA bifurcation to the superior border of thyroid cartilage (SBTC), angle of mandible, ear lobule were measured. The ddistances of STA, LA & FA from CCA bifurcation were also measured.

Results: In 16 (53.33%) cases the bifurcation of CCA was observed at the level of SBTC, 2 (6.67%)

It was between SBTC and hyoid bone, in 5 (16.67%) below SBTC and in 6 (20%) at the level of hyoid bone. The mean distances from the bifurcation of CCA to the SBTC was 24 ± 0.95mm, to the angle of the mandible was 31 ± 0.86mm and to the ear lobule was 54.8 ± 0.96mm. The mean distances of STA, LA and FA from CCA bifurcation were 7.2 ± 0.2, 12 ± 0.45 and 17.6 ± 0.48 cm respectively.

Conclusion: The anatomical study of CCA is useful for angiographies, thyroid and head and neck surgeries. In case of common trunks, stenosis or occlusion may cause severe ischemic consequences and prone to atherosclerosis.

KEY WORDS: Common Carotid Artery, External Carotid Artery, Superior Thyroid Artery, Lingual Artery, Bifurcation.

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INTRODUCTION

The common carotid arteries (CCA) supply the head and neck region. The CCAs usually divide at the upper border of the thyroid cartilage (SBTC) into external and internal carotid arteries [1]. The external carotid artery (ECA) extends from the SBTC to the neck of the mandible, providing eight branches which includes the terminal superficial temporal and maxillary branches. The CCAs may bifurcate higher or lower than the usual levels. The bifurcation can occur as high as the hyoid bone, or as low as

the cricoid cartilage [2].

ECA is the main artery of head & neck region. Superior thyroid artery (STA) is the first anterior branch of the ECA, arising just below the level of the greater cornu of the hyoid bone. Lingual artery (LA) is the second anterior branch and the principal artery of the tongue arising opposite the tip of greater cornu of hyoid bone. The facial artery (FA) normally arises at the level of greater cornu of hyoid bone in the carotid triangle [3, 4].

The anatomical variations of these arterial branches can pose a dangerous situation during surgeries like thyroidectomy, laryngectomy and arterial angiograms and in the resection of head and neck tumors. Hence it is essential for surgeons and radiologist to be aware of the variations among these arteries [5, 6]. Variations of the blood vessels of the neck and their explorations are essential for a better anatomic knowledge of the neck. [7, 8].

The level of bifurcation of CCA and the pattern of branching of ECA show multiple variations which would be essential to consider during neck dissection surgeries. Encounter of such variations during surgeries may lead to fatal damage to the branches leading to hemorrhage [9].

The aim of the present study is to describe the variations of the level of bifurcation of CCA in relation to important anatomical landmarks, as well as to report the variations and morphometry of anterior branches of ECA.

MATERIALS AND METHODS

Study design and study period: The present observational study was carried on 30 sagittal sections of head and neck specimens in one year. The dissected specimens were procured from the Department of Anatomy, Kasturba Medical College, Manipal.

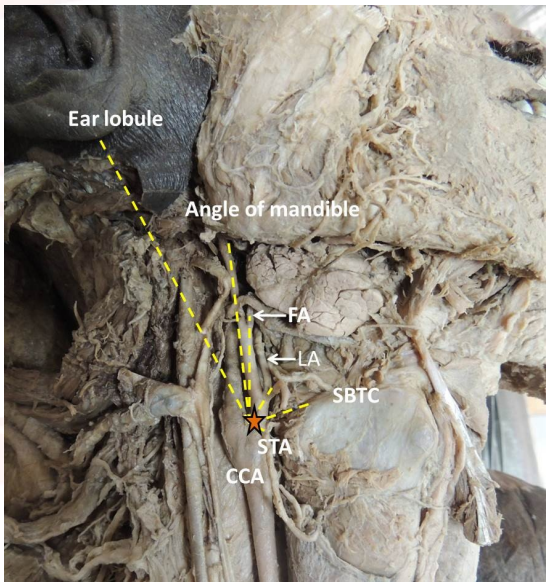
Exclusion criteria: The specimens in which the embalming was done using the carotid arteries and the specimens with the variations of branching pattern were excluded from the study.

Data collection: The sides of the neck were dissected and the carotid arteries were observed. The bifurcation level of CCA was observed with reference to the upper border of thyroid cartilage.

The anterior branches of CCA (superior thyroid, lingual and facial) were noted and their distances from the point of origin to the bifurcation of CCA were measured. The distances were also measured from the bifurcation of CCA to the upper border of thyroid cartilage, angle of the mandible and the ear lobule using digital callipers (Guilin Guanglu Measuring instruments Co. LTD, China). The specimens were photographed for documentation. The parameters measured are shown in figure 1.

Mean and standard deviations of the measured parameters were calculated using SPSS version 16.

Fig. 1: Side of the neck showing the carotid arteries and the distances measured.



CCA: Common carotid artery, STA: Superior thyroid artery, SBTC: Superior border of thyroid cartilage, LA: Lingual artery, FA: Facial artery

Distances measured:

1- Bifurcation of CCA to superior border of thyroid cartilage

2- Bifurcation of CCA to the origin of lingual artery

3- Bifurcation of CCA to the origin of facial artery

4- Bifurcation of CCA to the angle of mandible

5- Bifurcation of CCA to the ear lobule

RESULTS

Out of 15 cadavers used, 12 were males and 3 were females. The levels of bifurcation of CCA

was described based on the landmarks and is shown in table 1. The distance from the bifurcation of CCA to the superior border of thyroid cartilage was 24 ± 0.95mm, to the angle of the mandible was 31 ± 0.86mm and to the ear lobule was 54.8 ± 0.96mm.

Table 1: Level of bifurcation of common carotid artery.

At the level of SBTC	Between SBTC & hyoid bone	Below SBTC	At the level of hyoid bone	Above the hyoid bone
16 (53.33%)	2 (6.67%)	5 (16.67%)	6 (20%)	1 (3.33%)

Mean distance of anterior branches of ECA from CCA bifurcation were calculated. The average distance of superior thyroid artery to the bifurcation of CCA was 7.2 ± 0.2mm, lingual artery was 12 ± 0.45mm and facial artery was 17.6 ± 0.48mm respectively.

No inferential statistics was applied to compare the parameters between two sides.

DISCUSSION

During the neck surgery, inadvertent injury to the CCA may cause hemorrhage and life-threatening complications. Knowing the normal anatomy and also its anomalies is important in preventing such complications. The thoracic and lower cervical bifurcation of the CCA are rarely seen anomalies [10]. Orr first reported the case of the lower cervical carotid artery bifurcation in 1906 [11].

Level of bifurcation of CCA: Study done by Al-Rafiah et al on 60 CCAs in the sagittal section of the head and neck showed normal bifurcation of the CCA in 48.3% of cases. The level of bifurcation in 29 cases (48.3%) corresponded to the upper border of the thyroid cartilage. In 15 (25%) cases, the level was found opposite to the body of the hyoid bone and eleven (18.3%) cases showed the bifurcation at a higher level than the upper border of the thyroid cartilage. The bifurcation in 3 (5%) cases was at a lower level than the upper border of the thyroid cartilage. In two (3.3%) cases the bifurcation was at a higher level than the hyoid bone [5].

Normal division of CCA was found in 50% of cases in the study done by Lucev et al and 58% of were reported by Ilic et al [9,12]. A higher percentage was found in the studies done by Espalieu et al (65%) and Von Poisel and Golth (67%) [13]. In the present study the bifurcation at the level of SBTC was seen in 16 (53.33%) cases.

In Al-Rafiah et al study a high bifurcation of CCA is more commonly observed, in some cases it was as high as the hyoid bone or as low as, the inferior border of the thyroid cartilage. But the percentages were not calculated [5]. Standring has stated a higher level of bifurcation opposite the hyoid bone and reported this level as the most commonly observed bifurcation level. He also stated that in 18.3% of cases CCA bifurcated at a higher level than the SBTC [3].

This finding corresponded to Von Poisel & Golth and Krmpotiæ- -Nemaniæ et al who found it in 20% of cases [14, 15].

Standring mentioned that in 5%, level of CCA bifurcation was below the SBTC [3]. Iliæ et al. [12] found this level in 11% of cases and Lucev et al [9] in 12.5% of cases. In the present study the bifurcation of CCA was found between the SBTC & hyoid bone in 2 cases (6.67%). It was below the SBTC in 5 cases (16.67%), at the level of hyoid bone it was seen in 6 cases (20%) and above the hyoid bone it was seen in 1(3.33%) case. These variations should be kept in mind during surgical approaches in the head and neck region.

Morphometry of the anterior branches of ECA: Study done by Al-Rafiah et al concluded that the distance of the origin of the STA from CCA bifurcation ranged from 0.2 to 3.3 cm [5]. Lo et al observed that the origin of the STA to be at the level of the CCA bifurcation. They reported that the high CCA bifurcation should stress the surgeons while operating the area related to the hypoglossal nerve as both are closely related to each other [16]. In the present study the mean distance of STA to the CCA bifurcation was 7.2 ± 0.2mm, LA was 12 ± 0.45mm and FA was 17.6 ± 0.48mm respectively.

In the present study we also measured the distances from the bifurcation of CCA to the SBTC (24 ± 0.95mm), the angle of the mandible (31 ± 0.86mm) and to the ear lobule (54.8 ± 0.96mm). No literature was available to compare these parameters.

Ozgur et al. highlighted that knowledge of the

CCA and its branches are important to ensure accurate arterial ligation during vascular surgical procedures in the neck region. This knowledge can help the radiologists to understand and interpret carotid angiograms [1].

Limitations of the study: The present study was carried out using formalin fixed cadavers. Therefore the parameters would vary in mm in living persons. The study was done using 30 sagittal sections, in future the study could be extended with more number of specimens.

CONCLUSION

As the variations of CCA bifurcation and the branches of ECA are of clinical significance the present study attempted to highlight surgically relevant variations and also reported the parameters which were not considered in the literature previously.

Conflicts of Interests: None

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