

Anatomical study of high bifurcation of common carotid artery in human cadavers

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Abstract

Aim and Objectives: The present research was carried out with an objective to study the level of bifurcation and its anatomical variations of common carotid artery (CCA).

Methods: Fifty human cadavers (24 males and 26 females) were dissected and the level of bifurcation and its anatomical variations of CCA were noted and results were analyzed statistically.

Results: The level of bifurcation of CCA at the superior border of thyroid cartilage was noted in 68 % of cases while higher and lower level of bifurcation was seen in 22% and 10% of the specimens respectively. High and low level bifurcation of CCA was highly significant on right side compare to left.

Conclusion: The bifurcation of common carotid artery need not always be at the level of upper border of thyroid cartilage. It can be at either higher or lower in origin, higher being more common. The awareness in the variation of bifurcation level is necessary to avoid undue complications during the surgeries and procedures done in head and neck region.

Keywords: Bifurcation, Anatomical variations, Common carotid artery (CCA), Superior border of thyroid cartilage, Linguofacial trunk, Occipitauricular trunk.

1. Introduction

Common carotid arteries (CCAs) are the largest bilateral arteries of head and neck, right usually arises from the brachiocephalic artery behind the sternoclavicular joint, while the left arises from the arch of the aorta and has therefore a thoracic as well as a cervical course [1]. They form an important landmark in head and neck surgery and defining the plane of the dissection during radical neck surgery [2]. Conventional angiography is considered the most accurate technique for diagnosis of carotid bifurcation diseases, such as stenosis [3]. Thus, accurate evaluation of the carotid bifurcation level with non invasive techniques remains an important goal.

Carotid artery surgery is fraught with danger and it requires meticulous dissection in an area of complex anatomy. There is a lack of consensus among various

anatomy texts as to the correlation of the common carotid artery (CCA) and its surrounding structures. To help minimize operative morbidity and mortality in patients undergoing operations, involving the CCA, a clear understanding of the anatomy is essential [4]. Similarly the knowledge of point of bifurcation of CCA is very important in surgeries of head and neck region to prevent vascular accidents, during catheterization of carotid arteries and intra-arterial administration of chemotherapeutic agents [5].

In spite of the large number of anatomical variations of carotid arteries in their point of bifurcation, scanty literature is available in Indian subjects; most of the literatures available are case reports. Therefore considering its clinical and surgical importance in head and neck surgeries and various procedures the present study was

undertaken to know the level of bifurcation and variations of level of bifurcation of CCA in human adult cadavers.

2. Material and Method

The present observational study was carried out on hundred human carotid specimens obtained from the formalin embalmed cadavers allotted to the undergraduate students for dissection in the Department of Anatomy at medical colleges. Study included cadavers of different age groups and both sexes. The hemisectioned head and neck specimens which were allotted to students of previous year were also included. Cadavers having injury to ECA and nomalous tortuosities, dilatations, aneurysms or atheromatous/ occlusive disease specimens were excluded from the study.

The dissections were carried out according to the instructions given in Cunningham's manual of practical anatomy [6]. The level of bifurcation of common carotid artery was noted and each specimen was observed for the variations in level of bifurcation. The results of the levels of bifurcation and its variations were summarized and analyzed statistically.

2.1 Statistical Analysis

Descriptive statistics (Percentage, Mean and Standard deviation) was used to summarize baseline characteristics of the study subjects. Various data obtained from dissection of human cadavers and variations were noted and analyzed using STATA VERSION-10 statistical software. Chi square test, Chi square test for trend, Fisher's exact test was used to analyze data.

3. Observations and Results

We studied the 100 carotid specimens of total 50 human cadavers of which 24 (48%) were male and 26 (52%) were female. Age of the persons examined varied from 41 to 80 years with maximum numbers of cases in age groups of 41 to 50 years. We studied 50(50%) carotid specimen on right side and 50 (50%) carotid specimen on left side. The normal level of bifurcation of CCA at the superior border of thyroid cartilage was noted in 68 % of cases (Image I) while higher level of bifurcation was seen in 22% of cases (Image II) and lower level of bifurcation was seen in 10% of the specimens (Image III). Table 1 predicted that the high level of bifurcation of CCA was more common than low level of bifurcation as well as both the levels (high and low) was highly significant on right side compare to left.

Table 1: Level of bifurcation of CCA on right and left side among study group

Sides	Level of bifurcation of CCA		
	High	Low	Normal
Right	16 (72.7%)	9 (90%)	25 (36.8%)
Left	6 (27.3%)	1 (10%)	43 (63.2%)
Total	22	10	68
P-Value	<0.001, HS		

HS-Highly significant

The branching pattern of CCA showed variations. Superior thyroid artery was arising directly from CCA in 24 specimens (24%), on right it was 14 (58.3%) and on left it was 10(41.6%). Superior thyroid artery was originated at bifurcation level in 5(100%) cases on right side and on left side no case was observed (0%).

Figure I: Normal level of bifurcation of CCA at the level of superior border of thyroid cartilage

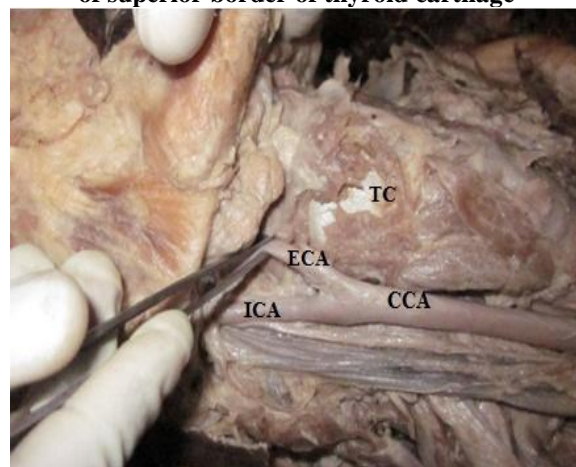


Figure II: High bifurcation of CCA above upper border of superior border of thyroid cartilage

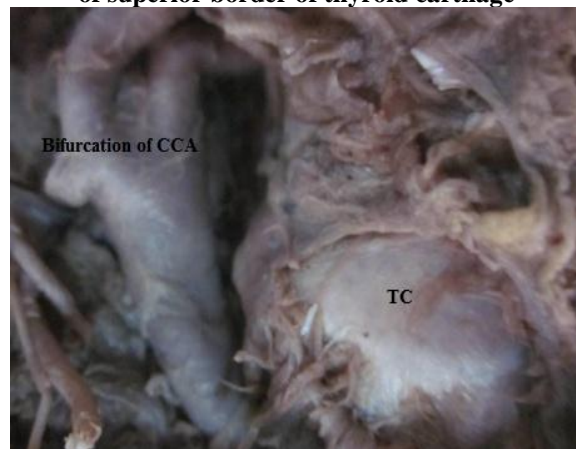
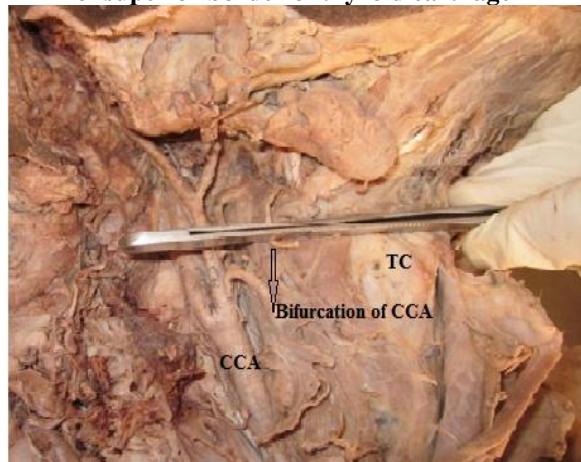


Figure III: Low bifurcation of CCA below upper border of superior border of thyroid cartilage

4. Discussion

It is commonly accepted that the CCA bifurcation occurs at about the level of the 4th cervical vertebra for clinicians [7]. Nevertheless, most anatomical text books and references in the literature describe the upper border of the thyroid cartilage as the bifurcation level, With the advent of the radiological investigations, and the need of a more accurate interpretation of them, external anatomical landmarks turned to be useful, in regular clinical practice [8,9]. The level of the CCA bifurcation is subject to individual variations; the CCAs may bifurcate higher or lower than the usual levels [10]; a high bifurcation is more common, the bifurcation can occur as high as the hyoid bone (C3) or even the styloid process, or as low as the cricoid cartilage (C6). Variations are of importance for surgical approaches in the head and neck region [10].

In present study, we studied the level of bifurcation of CCA with respect to upper border of thyroid cartilage in 100 carotid specimens out of which 22(22%) cases showed high level of bifurcation of which 16(72.7%) on right side and 6(27.3%) on left side while 10(10%) cases showed low level of bifurcation of which 9(90%) on right side and 1(1%) on left side. Normal level of bifurcation was seen on right side was 25(36.8%) cases and on left side it was 43(63.2%) cases, total of 68(68%) cases were normal. The findings of our study were correlated with previous studies [11-14].

Human anatomy texts have given very little precise information about the frequency of variations in the bifurcation of the common carotid artery and its branching pattern. Anatomical variations occur throughout the course of carotid arteries. Variations may occur in origin, branching pattern or in the level of bifurcation point. However, variability in position of the carotid bifurcation point is well documented. Inamasu and Guiot [15] showed individual variation regarding bifurcation of CCA in their *IJBAR* (2017) 08 (07)

work. This could be due to differences in the level of embryological origin of the external carotid artery [16]. Normally ascending pharyngeal artery arises as a slender artery from the medial surface of ECA near its origin. No variations were seen in the origin of ascending pharyngeal artery in our study. Superior thyroid artery arises from the front of ECA just below the level of greater cornu of hyoid bone [17]. The commonest variation in the origin of superior thyroid artery encountered was its origin from CCA. In current study the superior thyroid artery most frequently arose from the external carotid artery on left side compare to right, followed by common carotid artery and at bifurcation level on right side. Our findings coincide with the findings of Nakamasa *et al* [18].

In 6 (6%) cases lingual artery arose from bifurcation point and no case was found in which the lingual artery arose from CCA. On right side the lingual artery was originated at bifurcation level in 5(83.33%) cases and on left side it was 1(16.66). The linguofacial trunk was seen in 11(61.11) cases on right side and in 7(38.88%) cases on left side, this was comparable with studies of Nakamasa, Zumre, and Mata J R who reports 18% [18], 20% [19], 19.4% [20] cases of LFT respectively. On right side we observed only 1(100%) case showing common trunk of lingual artery with superior laryngeal artery and on left side there was no such pattern was seen. A thyrolingual, thyrolinguofacial trunk was not observed in the present study. The commonest variation noted was the occurrence of linguofacial trunk, and occipitauricular trunk followed by the origin of superior thyroid artery from common carotid artery.

5. Conclusion

The bifurcation of common carotid artery need not always be at the level of upper border of thyroid cartilage. It can be at either higher or lower in origin, higher being more common. The anatomical knowledge of variability of carotid bifurcation levels will be useful for clinicians, to avoid unnecessary complications as well as for radiologists in the image interpretation of the face and neck region. Variations among CCAs are quite common therefore it becomes essential to do further study with large samples from different zones which will give more information on regional variations in the carotid arteries.

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