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Case Report

Infrahyoid wandering carotid arteries

Myroslav Gerasymchuck, MD, Syed Anwarulislam, DO, Ameya P. Nayate, MD*

University Hospitals of Cleveland, 11100 Euclid Avenue, Cleveland, OH 44106, USA

ARTICLE INFO

Article history:

Received 15 November 2019

Revised 2 January 2020

Accepted 7 January 2020

Keywords:

Retropharyngeal carotid arteries

Tortuous carotid arteries

Wandering carotid arteries

ABSTRACT

Knowledge of retropharyngeal carotid arteries in patients is important in order to avoid potential catastrophic injuries. Previous studies demonstrated that carotid arteries can change in position at or near the level of the hyoid bone on serial scans. We report the presence of wandering carotid arteries at the level of the cricoid cartilage and superiorly in the neck of a 74-year-old female patient over multiple months. The potential for carotid arteries to randomly change positions in the suprahyoid and infrahyoid neck should be known by clinicians to avoid misdiagnosing occult neck masses and to avoid potential arterial injury during neck surgery. Although the exact etiology for wandering carotid arteries remains uncertain, we propose that reduced axial tension on carotid arteries and increased body mass Index may play a causative role.

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Introduction

Retropharyngeal carotid arteries (RCA) are an important anatomic variant that can be a source of critical complications during medical procedures [1]. To avoid life-threatening hemorrhage or trauma that might potentially lead to cerebral infarction, physicians need to be aware of any deviation of these vessels from their normal lateral location within the neck [1]. Two recent case reports and a retrospective review documented changes in the positioning of carotid arteries at or near the level of the hyoid bone over 2 or more time points in patients without history of neck surgeries or masses [2–4]. Potential etiologies for changes in the carotid arteries at this location have been attributed to swallowing or incomplete carotid sheath fascia, however to this date, no clear etiology has been determined [2–5]. In the following case report, we

describe change in position of the carotid arteries at the level of the cricoid cartilage and offer 2 etiologies for this process.

Case report

A 74-year-old obese female patient with history of essential hypertension was noted to have a cardiac murmur and a subsequent echocardiogram demonstrated severe aortic stenosis. The patient was referred to cardiothoracic surgery to undergo an aortic valve replacement. A preoperative chest computed tomography (CT) with intravenous contrast was obtained when the patient presented to the ER with chest pain and revealed retropharyngeal course of the common carotid arteries, defined as located medial to the lateral border of the thyroid cartilage [4] at the level of the hypopharynx

* Corresponding author.

E-mail address: Ameya.Nayate@UHhospitals.org (A.P. Nayate).

<https://doi.org/10.1016/j.radcr.2020.01.014>

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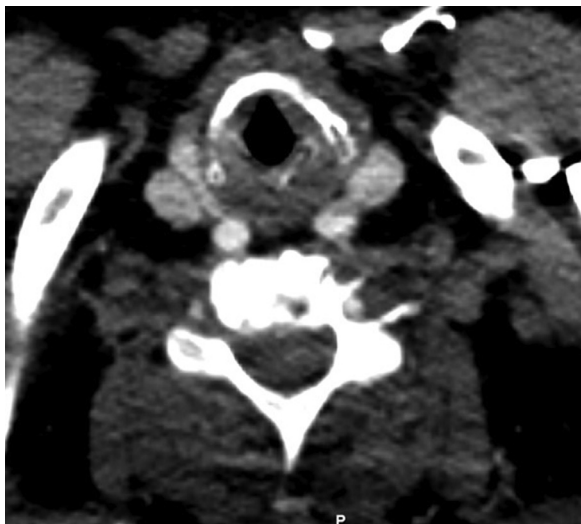


Fig. 1 – Retropharyngeal common carotid arteries are located at the level of the thyroid and cricoid cartilages.

and thyroid and cricoid cartilages (Fig. 1). A chest CT without intravenous contrast obtained for surgical planning 2 months later revealed the imaged portions of the common carotid arteries to be unchanged (image not provided). No images of the

more superior portions of the neck were obtained on either study.

Eleven days after the second CT chest, the patient underwent aortic valve replacement and a 23 mm freestyle bioprosthetic aortic root was placed in a modified subcoronary position. No surgery was performed on the aortic arch of the great vessels arising from the aortic arch. An intraoperative echocardiogram and an echocardiogram 3 days after surgery showed no complications.

The patient presented 4 months, 9 months, and 13 months after surgery to the ER with concern for brain infarcts and underwent CT angiogram (CTA) of the head and neck on each visit. Figures 1–4 demonstrate the change in position of the carotid arteries during those times.

Discussion

Due to potential for critical vascular injury, awareness of RCA is extremely important for any surgeries or procedures involving the retropharyngeal or surrounding tissues [1]. This anatomic variant is not uncommon, with 1 retrospective institutional review finding up to 18% of patients with at least 1 RCA [4]. Atherosclerosis, female gender, hypertension, tortuosity, and advanced age have all been proposed as potential etiologies for RCA [1,6–8].

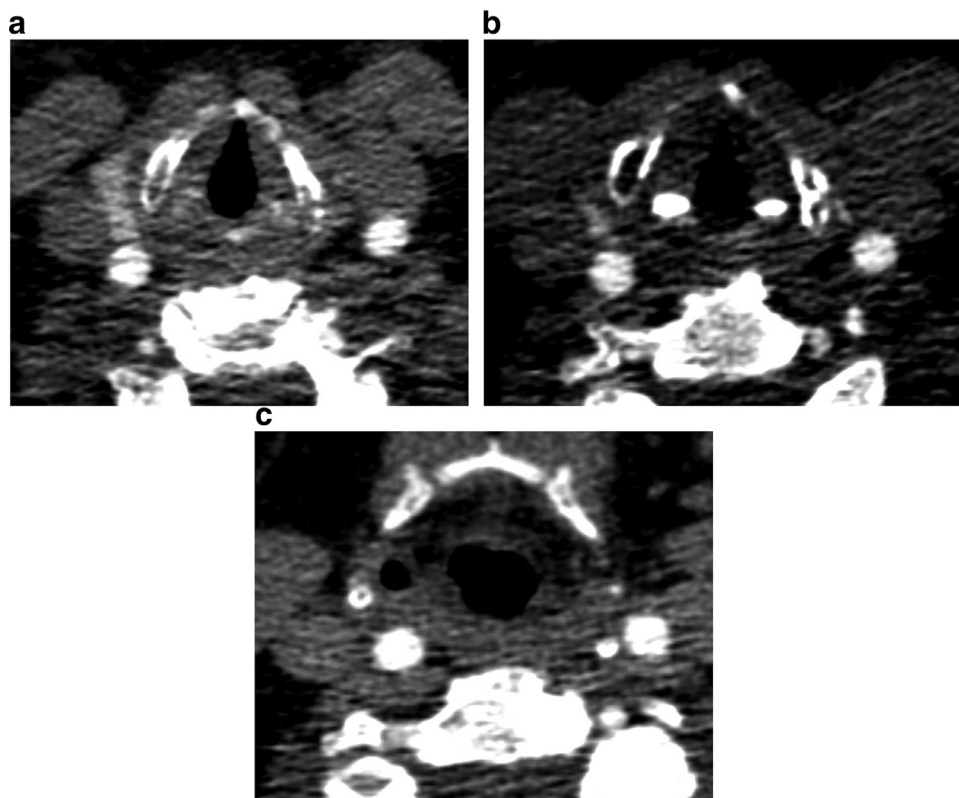


Fig. 2 – Four months after surgery. (A) CCAs are no longer in a retropharyngeal position at the level of the cricoid cartilage. (B) The right common carotid artery becomes marginal [4] in position superiorly at the level of the arytenoid cartilage, while the left common carotid artery remains lateral. (C) The right CCA becomes retropharyngeal in position at the level of the superior horn of the thyroid cartilage.

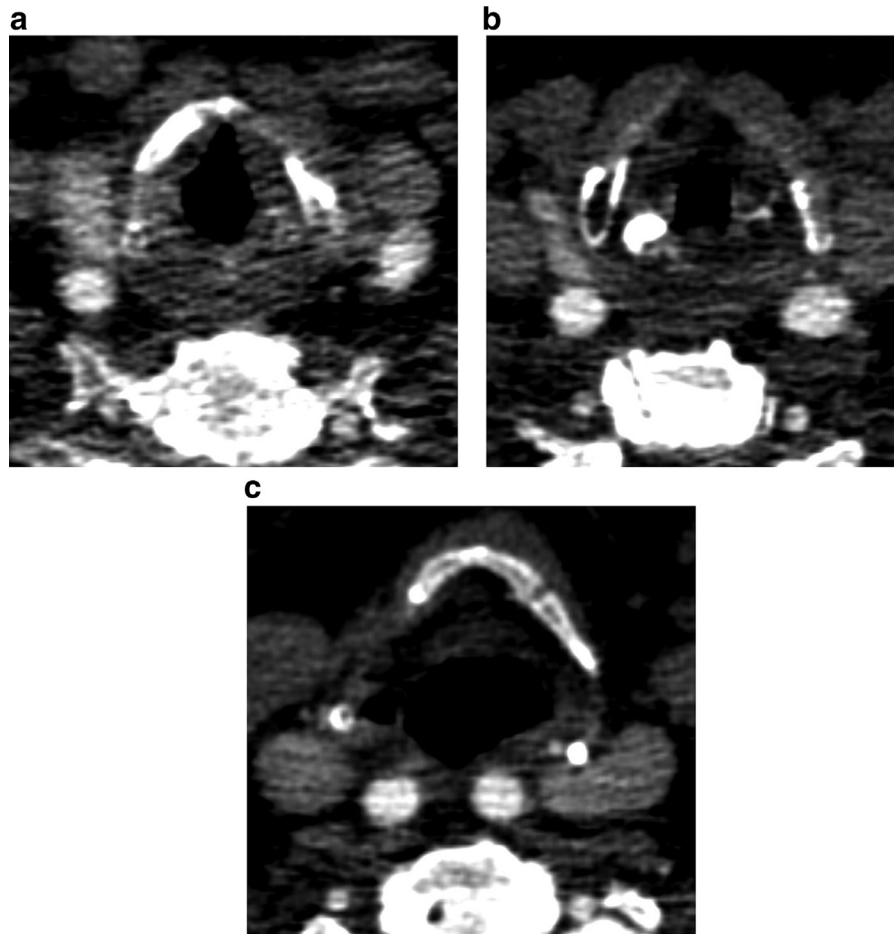


Fig. 3 – Nine months after surgery. (A) CCAs remain lateral to the thyroid and cricoid cartilages, although the distance between the left CCA and the thyroid cartilage has slightly decreased. (B) Both CCAs are marginal in location at the level of the arytenoid cartilage and retropharyngeal in location at the level of the superior horn of the thyroid cartilage (C).

Carotid arteries were believed to be relatively fixed in position. However, movement of the carotid arteries on imaging at different time points (within months) has been described in 2 recent case reports and a retrospective analysis at or near the level of the hyoid bone (total 6 cases). The average age of 5 of these patients was 51.8 years (age range 28–71, 3 male and 2 females). The other case report described the patient to be a female in the 50s. Incomplete fascial ring enveloping the carotid and jugular vessels in the suprahyoid neck and variance in anatomic position of the carotid arteries in relation to the physiological motion of swallowing have been proposed as 2 explanations for the change in position of the carotid arteries at or near the level of the hyoid bone [2–5]. However, the exact etiology, as stated by the authors of the case reports and retrospective analysis, remains unclear. These explanations would likely not account for the change in position of the carotid arteries from retropharyngeal to lateral in the infrahyoid neck at the level of the cricoid cartilage. This case report demonstrates that the change in position can also occur in the infrahyoid neck at the level of the thyroid and cricoid cartilage and we propose that the mechanism for changing positions may related to reduced axial tension on carotid arteries and increased body mass index (BMI).

Axial tension is defined as the lengthwise force applied to the carotid arteries. Prior experiments have demonstrated that age reduces axial tension and along with hypertension and weakened wall stiffness can lead to tortuosity of arteries and therefore change the position of segments of the carotid arteries in the neck [6,8,9]. The distal internal carotid arteries and the proximal aspects of the common carotid arteries were tortuous and remained so on all 3 CTA studies in our patient. A study by Hong J et al demonstrated that on CTA neck in 10 patients with tortuous distal carotid arteries, the proximal carotid arteries straightened when patient's neck was extended [10]. Although not stated in their article, Figure 5 from that article demonstrates the proximal left common carotid artery became more medial when the patient's neck was extended, however the tortuous portions of the carotid arteries located more distally remained unchanged. Furthermore, Vollmar J et al demonstrated that the amount of kinking or coiling can be decreased or increased by the position of the head [11]. A prior study demonstrated the change in position of the head between CT neck examinations seemed to have no clear association with the change in the position of the carotid artery from lateral to retropharyngeal and vice-versa [4]. However, this was a retrospective study which involved no direct

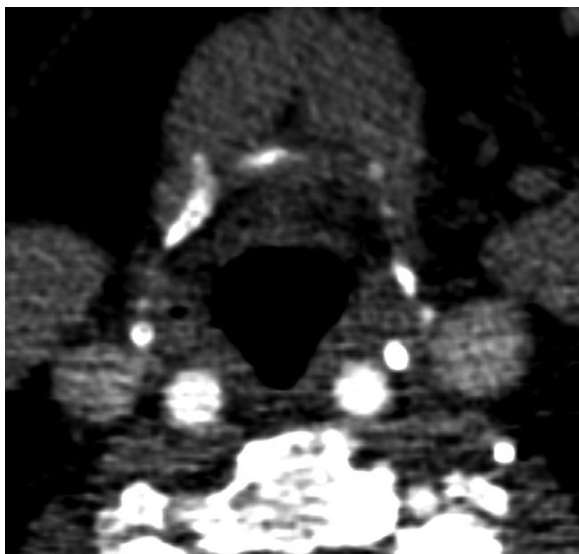


Fig. 4 – Thirteen months after surgery. The carotid arteries are retropharyngeal in location at the level of the superior horn of the thyroid cartilage. The distance between the left internal jugular vein and the carotid artery has increased. The CCA remain unchanged in position at the level of the cricoid cartilage (not shown).

manipulation of the patient's head prior to imaging to assess the change in positions of the carotid arteries.

Typically for CTA studies, the patient is asked to remain with head and neck in the neutral position. Our patient's head had no significant change in position on all 3 CTA studies and therefore we cannot comment if a change in head position would have affected the position of the carotid arteries. On the 2 CT chest studies, the patient's arms were raised above the head, while the on the CTA neck studies, the patient's arms were on the side. The carotid arteries were in the retropha-

ryngeal position at the level of the thyroid cartilage on the CT chest studies and moved on the subsequent CTA neck studies, therefore change in arm positions could potentially cause the infrahyoid carotid arteries to move. To confirm this, our patient will need to undergo multiple scans with arms in different positions.

Wang H et al demonstrated a direct relationship between tortuosity of the extracranial internal carotid artery and BMI, independent of other variables, which they partly attributed to intra-abdominal hypertension causing elevation of the diaphragm and mediastinum [12]. This elevation causes the CCA to rise and the distance from the cervical carotid artery origin to its termination at the skull base is reduced. The artery then becomes tortuous to maintain the same length and can change position since the carotid arteries are surrounded by loose connective tissue [12]. Although, the authors acknowledged that the etiology of tortuous internal carotid arteries is multifactorial and related to other entities including high blood flow (hypertension) and resulting arterial wall remodeling. Interestingly, our patient's BMI was in the 40s which is categorized as extremely obese and a patient with variable position of the carotid arteries described on another case report [3] had a weight of 102-103 kg which would be classified as at least obese, however the patient's BMI was not provided. In the retrospectively analysis or the other case report, patients' weight or BMI were not provided.

Our patient underwent prior aortic valve replacement and to our knowledge there has been no report about this surgery leading to change in position of the arteries arising from the aortic arch. Although, Irace C et al demonstrated that wall shear stress increases in the common carotid arteries after aortic valve replacement [13]. Wall shearing can lead to destruction of elastin which can lead to wall weakening and tortuosity [14]. To confirm this, a larger retrospective study will need to be performed on patient's that underwent aortic valve replacement.

Lastly, in our patient, the left carotid bulb slightly twisted medially on the most recent CTA neck and the angle of take

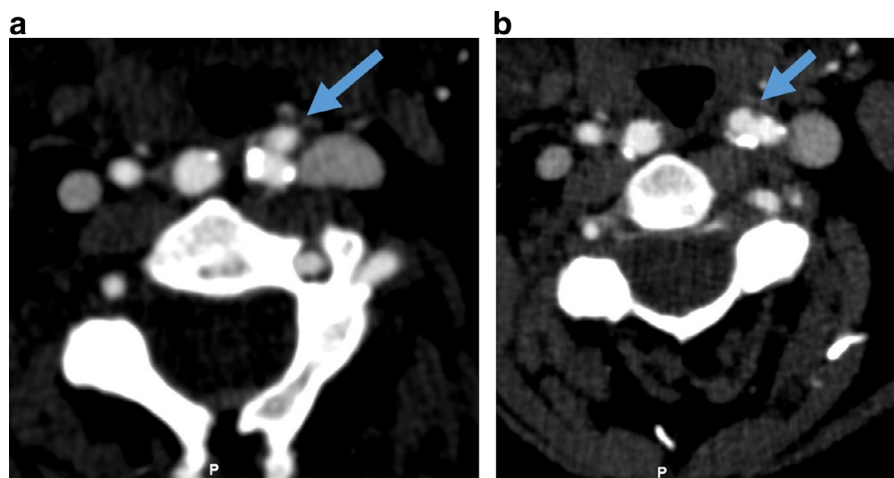


Fig. 5 – (A) and (B) show 2 scans 4 months apart (9 and 13 months after surgery, respectively). In (A), the left external carotid artery (denoted by arrow) arises laterally and anteriorly compared to (B). The orientation of the right external carotid artery was unchanged.

off the external carotid artery changed. To our knowledge, this finding has not been described previously. Furthermore, the distance between the internal jugular vein and carotid artery changed between the 2 most recent CTA neck studies. These findings could be related to incomplete carotid sheath fascia development in the suprahyoid neck.

Conclusion

We describe a case of the carotid arteries changing position in the infrahyoid neck at the level of the cricoid cartilage. As much as clinicians need to be aware of RCA in the suprahyoid neck, they also need to be aware that carotid arteries could be present in the retropharyngeal location in the infrahyoid neck and change position at a later point. Although an explanation for this phenomenon remains unclear, we propose that response of carotid arteries to reduced axial tension and increased BMI could be an integral part of the etiology.

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