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CASE REPORT

Unilateral Carotid Dolichoarteriopathy with Hairpin Kinking of the ICA and Looping of the ECA: A Case Report

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ABSTRACT

Extracranial carotid dolichoarteriopathies, including tortuosity, coiling, and kinking, are recognized variations of the carotid arterial system. The coexistence of marked kinking of the internal carotid artery (ICA) and prominent looping of the external carotid artery (ECA) on the same side is uncommon. During routine cervical dissection of a formalin-fixed adult male cadaver, the right ICA ascended linearly for 13 mm from the bifurcation before forming a sharp hairpin-like configuration (inner loop base width 3 mm, longitudinal span 39 mm). The ipsilateral ECA formed a large anterolateral loop (longitudinal span 53 mm, apex height 31 mm) that displaced the internal jugular vein laterally. No macroscopic atherosclerotic plaques or constricting bands were observed. This unusual combination may be important during selected head and neck procedures. Awareness of such variations and appropriate preoperative vascular imaging may aid surgical planning.

KEYWORDS

• Arterial kinking • Dolichoarteriopathy • Morphometry • Internal carotid artery • External carotid artery • Carotid artery variation

INTRODUCTION

The common carotid artery normally ascends through the neck and bifurcates into the external carotid artery (ECA) and internal carotid artery (ICA), although variations in the level of bifurcation are frequently documented.[1-4] Variations in the course and configuration of the extracranial carotid arteries are collectively described as dolichoarteriopathies and include tortuosity, coiling, and kinking.[8-12] These variations have been attributed to developmental factors as

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well as changes in arterial wall properties and mechanical influences.[4,8-10] Marked carotid arterial angulation may alter local blood-flow characteristics[13,14] and aberrant loops may become clinically relevant during procedures involving the pharyngeal, cervical, and skull-base regions.[6,16,17] The present report describes an unusual unilateral combination of a hairpin-like configuration of the ICA and prominent looping of the ECA within the same carotid triangle, along with its morphometric characteristics and relationship with adjacent structures.

CASE REPORT

During standard cervical dissection of a formalin-preserved adult male cadaver in the Department of Anatomy, All India Institute of Medical Sciences, Raipur, an unusual arterial configuration was identified in the right carotid triangle. The dissection was performed according to standard anatomical dissection procedures. Photographs were obtained before and after dissection, and morphometric measurements were recorded (Figures 1 and 2).

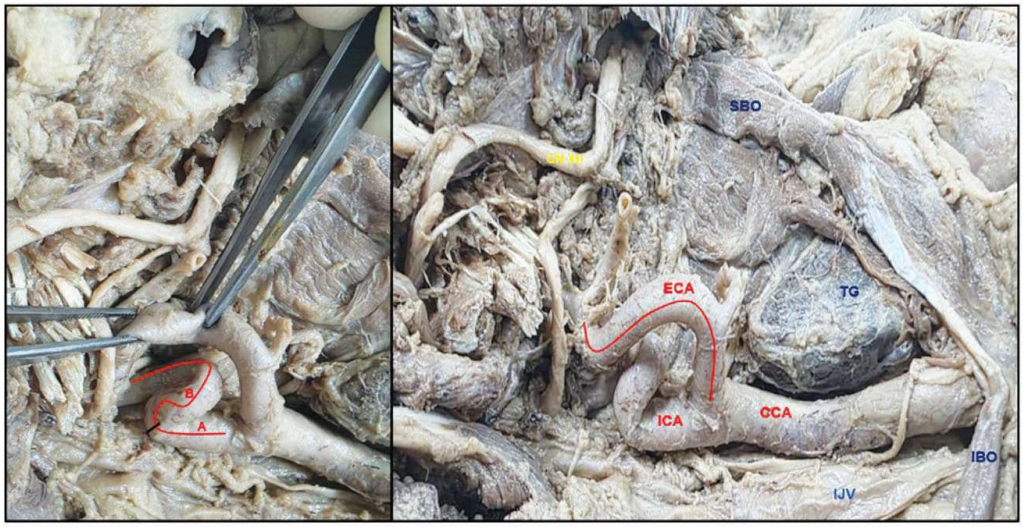


Figure 1: Right carotid triangle showing the looping and kinking of the internal and external carotid arteries and their relationships with adjacent structures. **A)** Straight segment of ICA; **B)** Looping/kinking of ICA; **CCA –** Common carotid artery; **ECA –** External carotid artery; **ICA –** Internal carotid artery; **IJV –** Internal jugular vein; **SBO –** Superior belly of omohyoid; **IBO –** Inferior belly of omohyoid; **CN XII –** Hypoglossal nerve; **TG –** Thyroid gland.

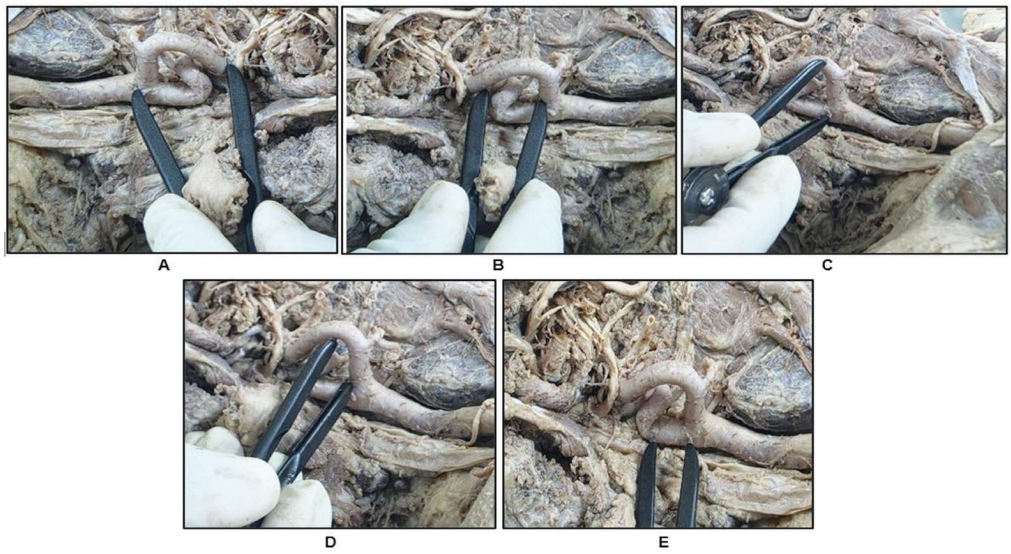


Figure 2: Morphometric measurements of the carotid arterial loops, **A)** Total outer loop base width; **B)** Total inner loop base width; **C)** Outer apex height from the carotid bifurcation; **D)** Inner vertex height from the carotid bifurcation; **E)** Pre-kink straight segment length.

After removal of the fibroareolar tissue from the carotid triangle, a longitudinal incision was made in the carotid sheath to expose the common carotid artery (CCA), internal jugular vein (IJV), and vagus nerve. The CCA ascended and bifurcated near the superior margin of the thyroid cartilage into the ECA anteromedially and the ICA posterolaterally.

The ECA formed a prominent anterolateral loop without alteration in the origin or branching pattern of its major branches. The ICA initially followed a relatively straight course for 13 mm from the carotid bifurcation. It then formed a sharp hairpin-like bend, with the ascending and descending segments closely apposed and displaced posteromedially beneath the ECA loop. Beyond this configuration, the ICA continued toward the carotid canal.

Morphometric measurements were obtained using tape, pointed dividers, thread, and a vernier caliper. The recorded parameters are presented in Table 1.

The surrounding structures were otherwise in their expected anatomical positions. The hypoglossal nerve passed between the arterial structures. The internal jugular vein was positioned lateral to the carotid arteries and was displaced further laterally by the ECA loop. The vagus nerve was located between the carotid artery and internal jugular vein.

No abnormal muscular slips, constricting fibrous bands, or significant macroscopic atherosclerotic plaques were observed around the kinked segments of the ICA or the looping segment of the ECA.

Table 1: Morphometric parameters of the right ICA and ECA loops

Anatomical Parameters	ICA	ECA
Pre-kink straight segment length	13 mm	NA
Total outer loop base width	17 mm	28 mm
Total inner loop base widt/h	3 mm	18 mm
Longitudinal loop span	39 mm	53 mm
Outer apex height from bifurcation	13 mm	31 mm
Inner vertex height from bifurcation	7 mm	15 mm

DISCUSSION

Morphological variations of the extracranial carotid arteries include tortuosity, coiling, and kinking, as described in the classical classification of Weibel and Fields.[9] Tortuosity generally refers to a curved or undulating course, coiling to a redundant looped configuration, and kinking to a sharp angular configuration of the vessel.[8,9]

In the present specimen, the ICA demonstrated a marked hairpin-like configuration with closely apposed arterial limbs. The inner loop base width measured only 3 mm, while the longitudinal span of the configuration was 39 mm. The ECA simultaneously formed a prominent anterolateral loop measuring 53 mm in longitudinal span and 31 mm in apex height.

The Togay-Işikay modification of the Weibel-Fields and Metz classifications categorizes ICA kinking according to the angle formed by the arterial segments: mild, moderate, and severe.[12] However, because the actual angle of the ICA kink was not measured in the present specimen, it would not be appropriate to assign a specific severity grade. Therefore, the configuration is described here as a marked hairpin-like kink rather than as mild, moderate, or severe kinking.

The simultaneous presence of ICA kinking and ECA looping on the same side represents an unusual anatomical arrangement within a single carotid triangle. The close relationship between the abnormal arterial courses and the internal jugular vein further increases the anatomical relevance of this finding.

Embryological and Morphogenetic Considerations

The extracranial carotid arteries develop through complex remodeling of the embryonic aortic arch system. Persistence of redundant vascular segments or alterations during vascular remodeling have been proposed as possible explanations for carotid tortuosity, looping, and kinking.[8,10] Congenital vascular elongation may provide an anatomical basis for some carotid arterial variations. Age-related changes in arterial wall properties and mechanical factors have also been proposed as possible contributors.[6,8,10] However, the precise mechanism responsible for the configuration observed in the present specimen cannot be established from the available anatomical findings. In particular, no clinical history, vascular imaging, or longitudinal observation was available to determine whether the observed configuration was congenital or acquired.

Hemodynamic Considerations

Previous computational and clinical studies have suggested that carotid angulation may alter local pressure gradients and blood-flow characteristics.[13,14] However, the present cadaveric study does not permit direct assessment of blood flow, pressure gradients, vessel compliance, or cerebral perfusion. Therefore, the hemodynamic significance of the configuration observed in this specimen remains theoretical. The narrow inner base of the ICA loop and the close apposition of its limbs indicate a marked alteration in arterial geometry. Computational and experimental studies have demonstrated that carotid kinking can be associated with changes in pressure distribution and flow characteristics.[13] Nevertheless, flow separation, vortex formation, pressure loss, cerebral hypoperfusion, or ischemia cannot be considered demonstrated findings in the present cadaveric specimen. Clinical studies have reported that morphological changes of the ICA are relatively common and have investigated their possible relationship with cerebrovascular events.[15] However, these observations should not be directly attributed to the present specimen because no clinical history or functional vascular assessment was available. Thus, the present case should primarily be regarded as an anatomical observation with potential clinical relevance rather than as evidence of a hemodynamically significant carotid lesion.

Surgical and Topographical Considerations

The anatomical arrangement observed in this specimen may have relevance during procedures performed in the upper neck, parapharyngeal region, and deep cervical spaces.

Posteromedial deviation of the ICA. The hairpin-like configuration resulted in posteromedial displacement of the ICA. Aberrant or medially displaced ICA loops may approach the pharyngeal or parapharyngeal spaces and may therefore be important during procedures involving these regions.[16] Paulsen et al. demonstrated that variations of the ICA course can bring the vessel into close relationship with the pharyngeal wall and tonsillar fossa, emphasizing their potential surgical relevance.[16]

Anterolateral looping of the ECA. The ECA formed a large anterolateral loop and displaced the internal jugular vein laterally. An unusually positioned or redundant ECA may alter the normal anatomical relationships encountered during cervical surgical procedures, including neck dissection and other procedures involving the carotid sheath.[17] The simultaneous presence of ICA kinking and ECA looping further emphasizes the importance of recognizing individual anatomical variations rather than assuming a uniform carotid arterial course. Preoperative vascular imaging with contrast-enhanced CT angiography (CTA) or magnetic resonance angiography (MRA) may be useful when a significant carotid arterial variation is suspected, particularly before procedures involving the parapharyngeal, skull-base, or deep cervical regions. Such imaging can help delineate the relationship of the abnormal arterial course to adjacent structures and assist in surgical planning. However, routine vascular imaging for every neck procedure cannot be recommended on the basis of a single cadaveric case.

CONCLUSION

This cadaveric case demonstrates an unusual unilateral combination of a marked hairpin-like configuration of the right internal carotid artery and prominent looping of the ipsilateral external carotid artery. The altered arterial courses and their relationship with the internal jugular vein and surrounding structures are of anatomical and potential surgical significance. Although the hemodynamic consequences of this configuration could not be assessed in the present cadaveric study, previous computational and clinical studies suggest that marked carotid angulation can influence local vascular hemodynamics. Awareness of such variations may be particularly relevant during procedures involving the parapharyngeal, skull-base, and deep cervical regions. When a significant carotid arterial variation is suspected, appropriate preoperative vascular imaging may help define the vascular anatomy and facilitate safer surgical planning.

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Conflict of Interest: The authors declare that there are no conflicts of interest.

Ethical Statement: The cadaver utilized in this study was obtained through the body donation program of the Department of Anatomy, AIIMS Raipur, and was used exclusively for educational and research purposes in accordance with institutional ethical guidelines and applicable regulations.

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