PROFESSIONAL ARTICLE

Computed Tomography Imaging Characteristics of Neck Paragangliomas: A Retrospective Analysis

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Abstract

Background/Aim: Paragangliomas are rare neuroendocrine tumours arising from paraganglia of the autonomic nervous system. Computed tomography (CT) imaging plays a crucial role in the evaluation and characterisation of neck paragangliomas. This retrospective study aimed to analyse the CT imaging features of neck paragangliomas to enhance diagnostic accuracy and delineate the radiological characteristics associated with these tumours.

Methods: A retrospective review of CT imaging studies of patients diagnosed with neck paragangliomas from March 2021 to October 2023 was conducted. Imaging characteristics including tumour location, size, enhancement pattern, vascularity, calcifications, adjacent tissue involvement and relationship with surrounding structures were analysed.

Results: A total of 87 patients with histologically confirmed neck paragangliomas were included in the study. CT imaging revealed typical findings of neck paragangliomas ie well-defined hyper-vascular masses with avid contrast enhancement, commonly located at the carotid bifurcation or along the carotid sheath. In addition, characteristic flow voids and the presence of feeding vessels were observed on CT angiography in a significant number of cases. The imaging analysis also identified calcifications and encasement of adjacent structures as frequent features of advanced-stage paragangliomas.

Conclusions: CT imaging of neck paragangliomas demonstrated consistent radiological features, including hypervascularity, contrast enhancement and distinct anatomic locations. Knowledge of these imaging characteristics is essential for accurate diagnosis and preoperative planning. Recognition of these features on CT imaging can aid in differentiating paragangliomas from other neck masses and facilitate appropriate management strategies.

Key words: Neck paraganglioma; Computed tomography; Diagnostic imaging; Hypervascularity.

Introduction

Paragangliomas are rare neuroendocrine tumours arising from the paraganglionic tissue of the autonomic nervous system, with the potential to develop in various anatomical locations. Approximately 3-5 % occur in the head and neck region.[1] Among head and neck paragangliomas, those located in the neck present specific diagnostic and management challenges due to their proximity to critical structures such as major blood vessels and cranial nerves. Within the neck,

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paragangliomas more commonly arise from the carotid body, vagus nerve and jugular paraganglia.[2]

Computed tomography (CT) especially contrast enhanced computed tomography (CECT) plays a crucial role in the evaluation of neck paragangliomas, not only providing detailed anatomical and functional information but offer additional insights into tumour characteristics and vascular involvement. Accurate diagnosis and characterisation of neck paragangliomas are essential for guiding appropriate management strategies, including surgical resection, embolisation and radiation therapy. CT imaging plays a pivotal role in the assessment of neck paragangliomas, providing detailed anatomical information and characterisation of these tumours.[3-6] However, the specific diagnostic imaging features of neck paragangliomas on CT which is essential for optimising the diagnostic and management strategies have not been comprehensively documented in available literature. By identifying consistent imaging findings, this study seeks to contribute to improved recognition and management of neck paragangliomas.

This retrospective study aimed to analyse the CT imaging characteristics of neck paragangliomas to enhance diagnostic accuracy and delineate the radiological features associated with these tumours.

Methods

A retrospective review of patients diagnosed with neck paragangliomas at Post Graduate Medical Institute (Sree Uthradom Thirunal Academy of Medical Sciences (SUTAMS), Thiruvananthapuram, India) from March 2021 to October 2023 was conducted. The study was authorised by Institutional Ethics Committee (IEC) of SUTAMS and informed written consent from all patients were taken before their participation.

Inclusion criteria were patients ranging in 18 to 80 years age group with slowly growing palpable neck masses who underwent CT evaluation. Patients with fever and having painful, inflammatory neck masses were not included in the study.

Multidetector CT (MDCT) examination was performed using 16-slice *Revolution CT scanner* (GE Medical Systems) and entire neck from petrous superior border to thoracic inlet was scanned craniocaudally within 10-15 s. CT angiography (CTA) was done for all patients using a *Medrad* pressure injector for pushing 80 mL non-ionic water-soluble contrast through a 18 G cannula into the antecubital vein at a flow rate of 4 mL/s. CT acquisition parameters were 120 kVp, 440 mAs, pitch of 1.375:1 at 1.25 mm slice thickness and 0.625 mm recon interval with a large FOV.

Evaluation for key CT features like location, degree of vascularisation, contrast enhancement features and presence of feeding arteries was conducted and findings were documented. CT findings were later correlated with histopathology / culture reports.

For statistical analysis the data observed were recorded and analysed using International Business Machines (IBM) Statistical Package for the Social Sciences (SPSS) version 20.0 software for Windows. Statistical significance was tested by Fisher's exact test. P-value < 0.05 was taken as significant.

Results

The CT imaging analysis of 87 patients satisfying the inclusion criteria showed hypervascularity and rapid wash in and wash out of contrast in all patients and arterial feeding vessels supplying the paragangliomas could be demonstrated in 80 patients (92 %) (Table 1). Paragangliomas including glomus (n = 37, 42 %) and carotid body tumours (n = 50, 57 %) were the commonest lesions.

Table 1: Computed tomography (CT) characteristics of paraganglioma

CT characteristics of paraganglioma	Yes n (%)	No n (%)	p-value*
Avid contrast enhancement/ hypervascularity	87 (100 %)	0 (0 %)	< 0.001
Feeding vessel	80 (92 %)	7 (8 %)	< 0.005
Rapid wash-in and wash-out	87 (100 %)	0 (0 %)	< 0.001

Fisher's-exact test;

Statistical analysis of CT study data revealed a significant correlation (p < 0.05) between hypervascularity, key contrast enhancement features and presence of feeding artery thereby establishing CT as a one shop stop for evaluation of neck

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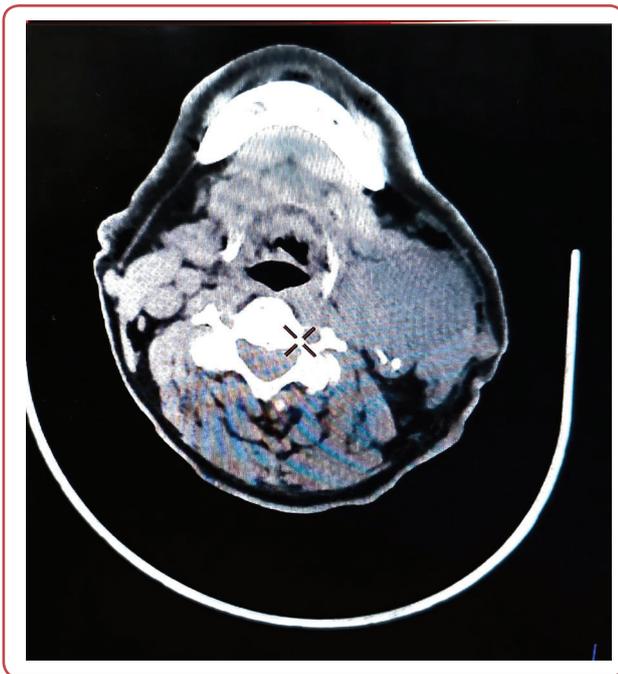
Figure 1: Plain computed tomography (CT) neck showing a soft tissue density lesion in the left anterior triangle region. No intralesional calcifications were seen.

Figure 2: Contrast enhanced computed tomography (CECT) neck demonstrates a well-defined avidly enhancing soft tissue mass at the carotid bifurcation with characteristic splaying of the internal carotid artery and external carotid artery. No evidence of adjacent infiltrative or inflammatory changes was seen.

paragangliomas negating the need for any other modality including magnetic resonance imaging (MRI). CT capabilities make it clear choice over MRA in identifying arterial feeders of paragangliomas due to its wider clinical accessibility and better patient tolerance profile (Figure 1 and 2).

Discussion

In presented study, paragangliomas including glomus (n = 37, 42 %) and carotid body tumours (n = 50, 57 %) were the commonest lesions which agreed with the study of Whalen RK et al[7] which stated that 80 % of extra-adrenal paragangliomas are either carotid body or glomus tumours. Study was concordant with Van den Berg et al[5] report in 2005 about the various CT imaging findings specific to common neck paragangliomas but their study was not a dedicated study in this topic while presented study was a retrospective study conducted with a good number of clinical cases. Boedeker et al[8] in 2004 published their experience in diagnostic ultrasound, CT and MRI evaluation of head and neck paragangliomas but as well with a limited number of cases.

Most of the literature on this topic was before 2010 and also was not specifically to do with common neck paragangliomas nor was it conducted as a retrospective study with a statistically significant number of patients. To authors' knowledge no recent studies on this important topic of imaging of neck paragangliomas were published in any journal of note. Hence this being a recently conducted study incorporates current demographics, imaging technology and data.

The comprehensive analysis of CT data in this study provides valuable insights into the imaging characteristics of neck paragangliomas. The observed correlations between specific CT features and clinical parameters highlight the potential of advanced imaging techniques in predicting clinical behaviour and guiding management decisions. The avid enhancement on contrast-enhanced CT images suggests a high vascularity of the tumours, which may have implications for preoperative embolisation and surgical planning. Vascular encasement or displacement when visualised on CECT can influence the choice of surgical approach and the risk of intraoperative bleeding or nerve injury. These findings underscore the importance of a multimodal imaging approach in the evaluation of neck paragangliomas and demonstrate the potential of CT in providing valuable prognostic information. CT imaging of neck paragangliomas demonstrates consistent radiological features including hypervascularity, contrast enhancement and distinct anatomic locations. Recognition of these imaging characteristics is crucial for accurate diagnosis and preoperative planning. The identification

of characteristic CT imaging features can aid in differentiating paragangliomas from other neck masses and guide appropriate treatment strategies. Familiarity with these imaging findings enhances the ability of radiologists and clinicians to recognise and characterise neck paragangliomas, ultimately contributing to improved patient care and treatment outcomes.

The only limitations of the study are the inherent contraindications of CT like allergy to iodine contrast, radiation risk and those patients with low e-GFR who could not be taken up for contrast CT studies.

Conclusion

This research article presents a comprehensive analysis of CT data on neck paraganglioma that offers valuable insights which aids in the radiological characterisation of neck paragangliomas and establishes CT imaging as a viable mean for accurate diagnosis with implications for therapeutic decision-making and potential for personalised treatment approaches in neck paragangliomas.

Ethics

All procedures performed in this study were in accordance with the ethical standards of the Institutional and / or National research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. The study was approved by Institutional Ethical Committee - SUTAMS IEC with approval No 49(3)/IEC/SUTAMS/2021, dated 1 March 2021.

Acknowledgement

Conflicts of interest

The authors declare that there is no conflict of interest.

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Data access

The data that support the findings of this study are available from the Sree Uthradom Thirunal Academy of Medical Science (SUTAMS) patient registry after obtaining permission from Chief Administrative Officer (CAO) and Institutional Ethical committee clearance upon reasonable individual request.

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Writing - review and editing: DR, DS
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Project administration: DR

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