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Case Report

Radiology Section

Cinematic Rendering for Preoperative Assessment of Retropancreatic Head Paraganglioma: A Case Report

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ABSTRACT

Retropancreatic paragangliomas are exceptionally rare Neuroendocrine Tumour (NET) that pose significant diagnostic challenges due to their imaging overlap with several peripancreatic and retroperitoneal pathologies, most notably pancreatic NET (pNET), Solid Pseudopapillary Neoplasms (SPNs), retroperitoneal schwannomas, and Pancreatic Ductal Adenocarcinoma (PDAC). The present report is of a 70-year-old male with an incidentally detected retropancreatic mass. Contrast-Enhanced Computed Tomography (CECT) demonstrated intense arterial enhancement, initially prompting consideration of pNET in the differential. Cinematic Rendering (CR) reconstruction revealed a characteristic "honeycomb" hypervascular architecture not previously described in the literature, precisely delineated preserved tissue planes between the tumour and adjacent major vascular structures, and definitively excluded vascular invasion. CR-guided preoperative planning enabled successful duodenum-preserving resection with minimal morbidity, avoiding traditional pancreaticoduodenectomy. Histopathology confirmed paraganglioma with benign features. This case illustrates that CR technology may aid in characterisation, showing potential for accurate preoperative diagnosis and organ-sparing surgical planning in complex retroperitoneal tumours.

Keywords: Arterial enhancement, Neuroendocrine tumours, Organ-sparing, Pancreaticoduodenectomy, Surgical planning

CASE REPORT

A 70-year-old man, showing no symptoms, had a pancreatic head mass incidentally detected on abdominal ultrasonography performed five months after thyroidectomy during routine postoperative follow-up. He denied any abdominal pain, epigastric discomfort, or back pain. The patient reported no symptoms suggestive of catecholamine excess, including palpitations, episodic headaches, profuse sweating, or anxiety attacks. There were no gastrointestinal symptoms such as nausea, vomiting, diarrhoea, or changes in bowel habits. He had a 3-year history of hypertension, well-controlled with amlodipine 5 mg once daily, maintaining blood pressure at approximately 120-130/70-80 mmHg. Additionally, he had been on levothyroxine 50 µg once daily following thyroidectomy for thyroid hormone replacement therapy. Laboratory investigations revealed that CA19-9 levels were within normal limits (2.06 U/mL; reference range: 0-28). Preoperative 24-hour urinary metanephrine and normetanephrine levels were also within normal ranges, measuring 12.55 µg/24h (reference: <42.5) and 18.06 µg/24h (reference: <57.1), respectively.

The CECT identified a well-circumscribed cystic-solid lesion (4.0×3.5×2.9 cm) posterior to the pancreatic head. Arterial-phase imaging showed intense enhancement of solid components [Table/Fig-1a], with persistent enhancement during the venous phase and non-enhancing cystic areas [Table/Fig-1b]. Magnetic Resonance Imaging (MRI) confirmed T2-hyperintense cystic components [Table/Fig-1c] and contrast-enhancing solid portions [Table/Fig-1d], initially suggestive of pNET.

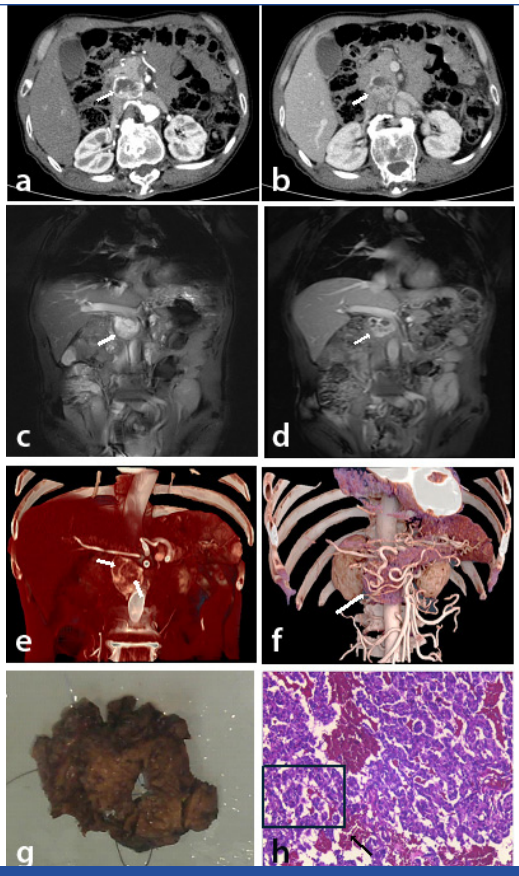
The CR imaging revealed a detailed architectural pattern characterised by hypervascular solid components exhibiting a distinctive 'honeycomb' vascular network of fine interlacing vessels, juxtaposed with hypoattenuating cystic regions [Table/Fig-1e]. CR clearly demonstrated that the tumour was situated anterior to the inferior vena cava and abdominal aorta, and was closely related to the gastroduodenal artery, pancreaticoduodenal artery, and right renal artery [Table/Fig-1f]. Notably, CR indicated that the tumour did not invade nearby main blood vessels, as the space between them remained intact.

The patient underwent a duodenum-preserving surgical resection 14 days after imaging diagnosis, following a thorough multidisciplinary evaluation. The procedure was performed under continuous intraoperative haemodynamic monitoring, during which blood pressure remained stable without clinically significant fluctuations, reflecting effective anaesthetic management and the tumour's biochemically non-functional nature. Intraoperatively, the tumour was identified as a well-encapsulated, highly vascular mass in the retropancreatic space. The tumour exhibited a characteristic reddish-purple appearance with prominent surface vascularity displaying the "honeycomb" pattern predicted by preoperative CR imaging. Careful dissection revealed preserved tissue planes between the tumour and adjacent structures, including the pancreatic head, duodenum, gastroduodenal artery, and superior mesenteric vein, confirming the absence of vascular invasion consistent with the CR imaging findings. The resected specimen demonstrated a well-defined capsule with heterogeneous solid-cystic architecture on the cut surface, measuring 4.0×3.5×2.0 cm [Table/Fig-1g].

Histopathological examination revealed characteristic architectural features consistent with paraganglioma. Microscopically, the tumour exhibited a classic nested (Zellballen) pattern, in which polygonal chief cells were arranged in compact clusters surrounded by delicate, highly vascularised fibrovascular septa [Table/Fig-1h]. The interspersed areas of haemorrhage between cell nests were readily apparent. The chief cells displayed uniform round-to-oval nuclei with finely granular chromatin and moderate-to-abundant eosinophilic cytoplasm. The patient experienced an uncomplicated postoperative recovery and was discharged on postoperative day 14. At 18-month follow-up, CECT demonstrated no evidence of local recurrence or distant metastasis. The patient remains asymptomatic with normal blood pressure control on the same antihypertensive regimen.

DISCUSSION

Paragangliomas are rare NET that arise from neural crest tissue, specifically from chromaffin cells, which are specialised chemoreceptors located along blood vessels [1]. Functionally active variants secrete catecholamines, manifesting as hypertension and palpitations, whereas non-functional lesions are typically discovered incidentally [2].



[Table/Fig-1]: Preoperative imaging characteristics of the retro-pancreatic paraganglioma: a) Axial Contrast-Enhanced CT (CECT) (arterial phase): A cystic-solid mass located posterior to the pancreatic head demonstrates pronounced enhancement of the solid peripheral components and internal septations; b) Axial Contrast-Enhanced CT (CECT) (venous phase): The solid portions exhibit moderately decreased yet persistent enhancement relative to adjacent pancreatic parenchyma, while cystic regions maintain non enhancement; c) Coronal T2-weighted MRI: The cystic component displays hyperintense signal intensity with hypointense internal septations; d) Coronal Contrast-Enhanced MRI: The solid components show marked contrast enhancement; e) CR 3D reconstruction (tumour morphology): Clearly illustrates the complex cystic-solid architecture, with the solid component exhibiting a fine "honeycomb" pattern (short arrows); f) CR 3D reconstruction (vascular anatomy): The tumour (long arrow) maintains distinct tissue planes with surrounding major vasculature, demonstrating no evidence of vascular infiltration; g) Gross specimen showing a well-defined capsule with heterogeneous solid-cystic architecture on the cut surface; h) Haematoxylin and eosin (H&E) staining (original magnification 100x): revealing the classic nested pattern with polygonal chief cells arranged in compact clusters (black box and arrow) surrounded by delicate fibrovascular septa.

The majority of reported retropancreatic paragangliomas manifest with symptoms attributable to mass effect or catecholamine hypersecretion. For instance, Zhou F-F et al., described a patient who developed cardiogenic shock secondary to catecholamine-induced takotsubo-like cardiomyopathy [3], while other reports have documented hypertensive crises, palpitations, and acute myocardial injury [4,5]. In marked contrast, in the present case, the patient remained completely asymptomatic, with the tumour identified incidentally during routine surveillance imaging. This silent clinical presentation, confirming the biochemically non-functional nature of the neoplasm, posed significant diagnostic challenges and underscores the importance of including paraganglioma in the differential diagnosis of retroperitoneal masses regardless of catecholamine secretory status.

As highlighted by Park JS et al., pancreatic paragangliomas can present as pancreatic masses with imaging characteristics mimicking pNET, often resulting in preoperative diagnostic uncertainty [6].

Critically, the clinical value of CR extends beyond its diagnostic capabilities to directly influence surgical management in ways that conventional imaging modalities cannot achieve. Rowe SP et al., reported that augmented reality applications utilising CR-derived three-dimensional reconstructions from volumetric CT data enabled surgeons to achieve a more precise spatial understanding of tumour-vessel relationships, facilitating operative planning beyond what conventional multiplanar reconstructions could provide [7]. Dappa E et al., demonstrated that CR provided superior depiction of soft-tissue interfaces, vascular architecture, and tumour boundary delineation compared with standard volume-rendering techniques derived from the same CT dataset, thereby enabling clinicians to make more informed preoperative surgical decisions [8].

In the present case, CR-guided preoperative planning enabled successful organ-sparing resection with minimal blood loss (50 mL) and uncomplicated recovery, representing a significant advancement in surgical management while maintaining oncological adequacy.

CONCLUSION(S)

Retropancreatic paragangliomas pose a formidable diagnostic challenge. This case suggests that CR technology may provide complementary information to standard CECT and MRI. Clinicians should therefore consider CR imaging an integral component of preoperative evaluation when managing complex retroperitoneal tumours that require detailed vascular and anatomical assessment for surgical planning.

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