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Case Series

Radiology Section

CT Imaging findings of Extra-adrenal Abdominal Paragangliomas: A Case Series

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ABSTRACT

Extra-adrenal paragangliomas are rare neuroendocrine tumours originating from paraganglia outside the adrenal glands. The present case series illustrates the Computed Tomography (CT) imaging features of three instances of extra-adrenal abdominal paragangliomas. The discussed cases include Retroperitoneal paraganglioma with Inferior Vena Cava (IVC) infiltration and associated hepatic, pancreatic, and skeletal metastasis; Inter-aortocaval paraganglioma; and Organ of Zuckerkandl Paraganglioma. The CT imaging features of the lesions and their relation with the adjacent vascular structures are described. The differential diagnosis and histopathological correlations are discussed. These cases underscore the importance of considering paragangliomas in the differential diagnosis of soft-tissue masses in the abdomen and highlight the role of Contrast-enhanced CT (CECT) imaging in their evaluation. Understanding the diverse imaging characteristics of extra-adrenal paragangliomas aids in accurate diagnosis and appropriate management. Further studies are needed to expand the authors knowledge of these rare tumours and optimise their imaging evaluation.

Keywords: Computed tomography, Inter-aortocaval paraganglioma, Metastatic paraganglioma, Neuroendocrine tumours, Organ of Zuckerkandl, Retroperitoneal paraganglioma

INTRODUCTION

The paragangliomas can manifest in multiple sites where normal paraganglia are located, but they tend to occur more commonly in specific regions such as the carotid body, jugular foramen, middle ear, aorticopulmonary region, posterior mediastinum, and abdominal para-aortic region including Zuckerkandl's body [1]. Approximately, 30% of pheochromocytomas and paragangliomas are linked to inherited mutations in genes such as Rearranged during Transfection (RET), Von Hippel-Lindau (VHL), Neurofibromatosis type I (NF1), and Succinate Dehydrogenase Subunits (SDHB, SDHC, and SDHD) [2,3].

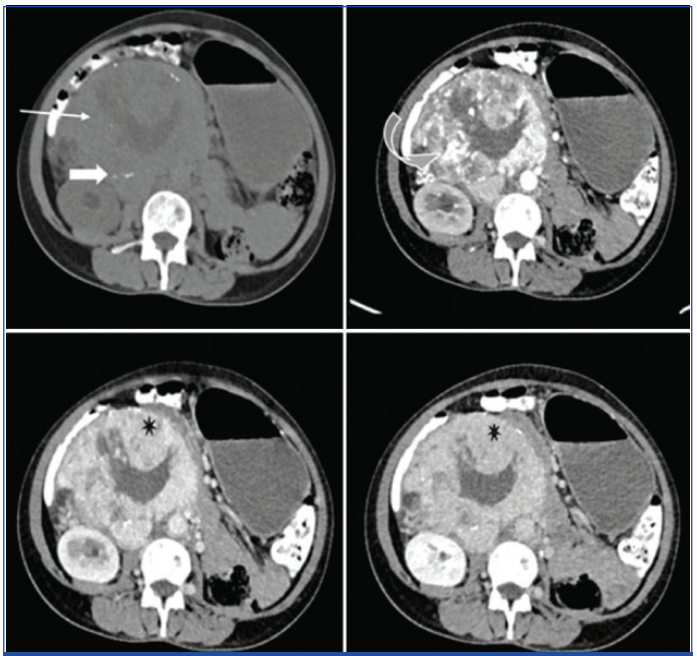
The extra-adrenal occurrences of paragangliomas, especially in the abdominal region, pose unique diagnostic and therapeutic challenges. The abdomen encompasses various critical structures, and the manifestation of paragangliomas in this region introduces complexities in both diagnosis and management. The present paper focusses on the CT imaging characteristics of these tumours, shedding light on their potential to mimic other abdominal masses and emphasising the importance of considering paragangliomas in the differential diagnosis.

Case 1

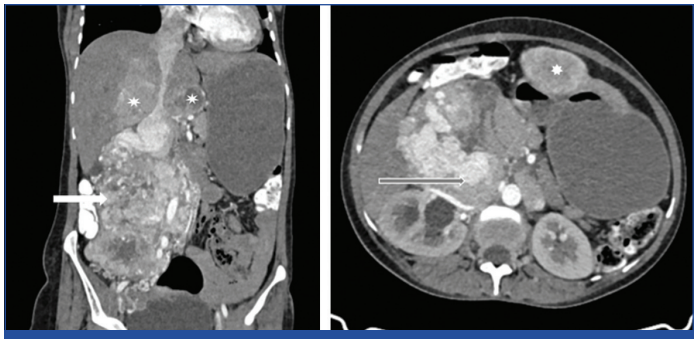
A 30-year-old female patient presented with a two-month history of abdominal distension and one month of swelling in both legs. On examination, her abdominal circumference at the umbilicus level was 70 cm. Palpation revealed a significantly sized, firm, and immobile swelling in the right lumbar and iliac region with distinct boundaries and mild tenderness. Additionally, the patient displayed pitting oedema in both lower limbs. Urinary catecholamines were within normal limits (68 mcg/24 hours).

A CECT abdomen and pelvis revealed a well-defined lobulated soft-tissue density mass lesion in the right retroperitoneum, measuring 11×8.5×16 cm. The lesion exhibited intense heterogeneous enhancement in the arterial phase and relative washout in venous and delayed phases [Table/Fig-1]. It displaced the D2 and D3 segments of the duodenum and the head of the pancreas anteriorly, extending into the right lumbar and iliac regions with mass effect on adjacent structures [Table/Fig-2]. The lesion also compressed the right proximal and mid ureter, leading to mild hydroureteronephrosis. Furthermore, it extended into the lumen of the suprarenal IVC, causing dilatation [Table/Fig-3]. It encased the right common iliac artery and the proximal aspect of the right external iliac artery.

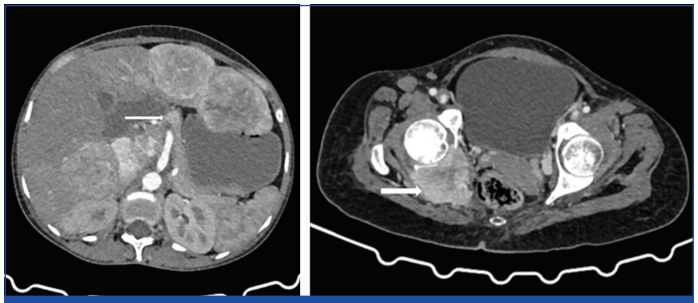
Multiple well-defined hypodense lesions were found in the liver, showing arterial phase hyperenhancement with a targetoid pattern [Table/Fig-4]. The pancreas exhibited a hyperenhancing lesion in the neck region. Additionally, lytic expansile lesions with cortical destruction and soft-tissue components were seen bilaterally in the hip bones, as well as a lytic lesion in the D10 vertebral body [Table/Fig-5-7].



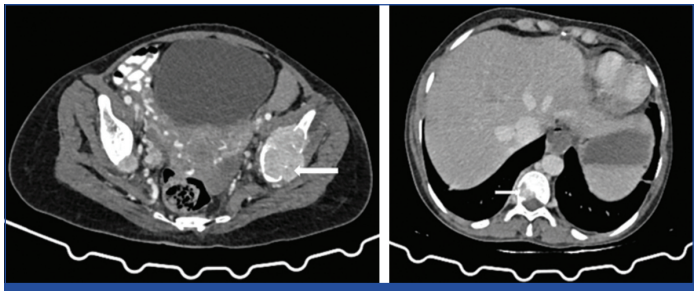
[Table/Fig-1]: A series of axial images of a representative section of abdomen, non contrast study (top left) and postcontrast study in arterial (top right), venous (lower left), and delayed phases (lower right) showing a well-defined lobulated soft-tissue density mass lesion in the right lumbar region (Thin arrow) arising from the retroperitoneum showing few specs of calcification in non contrast study (Thick arrow). The lesion shows intense heterogeneous enhancement in arterial phase (curved arrow) and relative washout in venous and delayed phases (*).



[Table/Fig-2]: Coronal section of postcontrast venous phase study showing the craniocaudal extent of the lesion in the right lumbar and iliac regions with mass effect on the adjacent structures (Arrow). Also, seen are heterogeneously enhancing hepatic lesions in both lobes (*).
[Table/Fig-3]: Axial postcontrast CT section of abdomen showing an enhancing lobulated component of the retroperitoneal lesion extending into the IVC with resultant dilatation of the IVC (Arrow). Also, seen is a heterogeneously enhancing hepatic lesion in the left lobe (*). (Images from left to right)

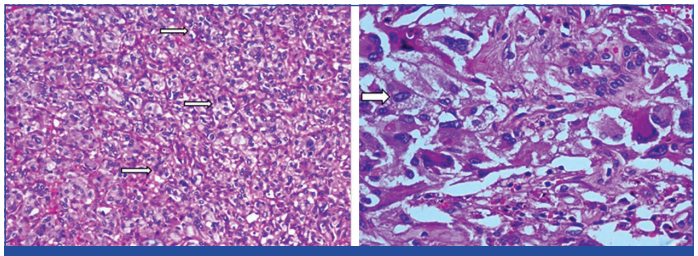


[Table/Fig-4]: Axial postcontrast CT section of abdomen in arterial phase showing multiple heterogeneously enhancing lesions in both the lobes of liver. Also, seen is an enhancing nodule in the region of neck of pancreas (Arrow).
[Table/Fig-5]: Axial postcontrast CT section of abdomen showing a destructive lesion involving the right hip bone near the acetabulum with heterogeneously enhancing soft-tissue component (Arrow). (Images from left to right)



[Table/Fig-6]: Axial postcontrast CT section of abdomen showing an expansile lytic lesion with cortical destruction involving the left acetabulum with heterogeneously enhancing soft-tissue component (Arrow).
[Table/Fig-7]: Axial postcontrast CT section of abdomen showing a lytic lesion in D10 vertebral body showing heterogeneous enhancement (Arrow). (Images from left to right)

A Ultrasound-guided (USG) core needle biopsy from the abdominal lesion revealed features consistent with Paraganglioma: neoplasm arranged in zellballen pattern and nests separated by thin vascular channels [Table/Fig-8]. Tumour cells exhibited salt and pepper chromatin with moderate eosinophilic cytoplasm and 1-2 mitoses per 10 high-power fields [Table/Fig-9].



[Table/Fig-8]: Photomicrograph of Haematoxylin and Eosin stained slide showing tumour cells arranged in nests (indicated by arrows) with a zellballen pattern separated by thin vascular channels at 10X magnification.
[Table/Fig-9]: Photomicrograph of Haematoxylin and Eosin stained slide shows round, oval to polygonal tumour cells having oval to elongated nuclei, and moderate amount of granular eosinophilic cytoplasm (Arrow) (40X). (Images from left to right)

Case 2

A 38-year-old male patient presented with vague abdominal pain persisting for 2-3 weeks. The pain was diffuse, non radiating, continuous, and non migratory. The patient has a history of uncontrolled hypertension for the past year. He denied any history of fever or other symptoms. An ultrasound revealed a heterogeneously hypoechoic mass lesion in the para-aortic region. Laboratory findings showed elevated urinary catecholamines (221 mcg/24 hours), while serum beta Human Chorionic Gonadotropin (HCG) and Acute Flaccid Paralysis (AFP) levels were within normal limits. A CECT abdomen and pelvis scan revealed a well-defined soft-tissue density retroperitoneal lesion measuring about 4.1×4.4×5.2 cm in the preaortic region, abutting the IVC and the descending thoracic aorta posteriorly [Table/Fig-10]. The lesion exhibited heterogeneous postcontrast enhancement and caused indentation and luminal narrowing of the IVC without thrombosis [Table/Fig-11]. No calcific foci were observed within the lesion [Table/Fig-12]. The lesion extended from the lower endplate of L2 to the upper endplate of L4 vertebral body. Other abdominal structures appeared unremarkable.

The imaging differentials included Gastrointestinal Stromal Tumour (GIST), extragonadal germ cell tumour, and paraganglioma. However, considering the patient's chronic hypertension and elevated urinary catecholamine levels, inter-aortocaval paraganglioma was suspected. Surgical resection confirmed the diagnosis of extra-adrenal paraganglioma through histopathology [Table/Fig-13,14].

Case 3

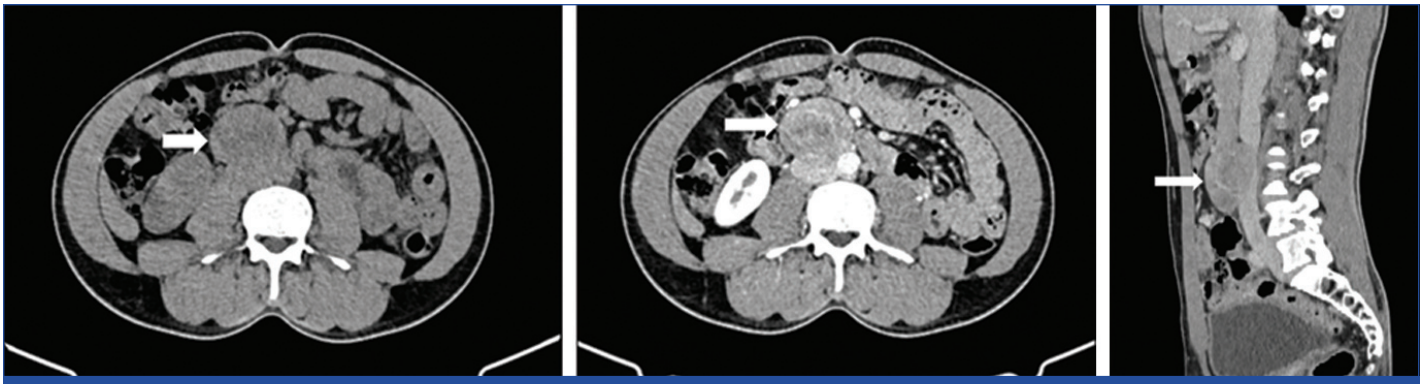
A 42-year-old female patient complained of left-sided abdominal pain persisting for two weeks, characterised as insidious in onset, dull aching, continuous, and non migratory with no aggravating factors. Medications provided relief. The patient has a history of uncontrolled hypertension for the past three years. Upon palpation, a firm, fixed mass was felt in the left hypochondriac region. Laboratory findings showed normal urinary catecholamine levels. CECT Abdomen and Pelvis revealed a large, soft-tissue density, heterogeneous attenuation lesion in the left lumbar region, measuring about 7×8.1×11.1 cm [Table/Fig-15]. The lesion exhibited intense postcontrast enhancement in the arterial phase and relative washout in the venous phase, with heterogeneous peripheral enhancement and non enhancing necrotic areas [Table/Fig-16]. It was located in the left para-aortic region at the level of the origin of the inferior mesenteric artery (Organ of Zuckerkandl region) [Table/Fig-16,17]. The lesion abutted the left kidney and descending colon with maintained fat planes posteriorly, and prominent veins draining the lesion into the left renal vein. Other abdominal structures appeared unremarkable [Table/Fig-18].

The imaging differentials included Paraganglioma, GIST, and sarcoma. After a core needle biopsy, the diagnosis of Paraganglioma was confirmed.

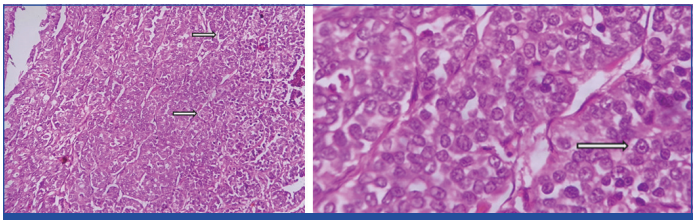
DISCUSSION

Pheochromocytomas outside the adrenal glands often develop in the upper para-aortic area, situated between the diaphragm and the lower poles of the kidneys. The traditional teaching underestimates their prevalence, with potentially 15% of adult and 30% of childhood pheochromocytomas being of extra-adrenal origin [4]. These cases underscore the imaging characteristics of extra-adrenal abdominal paragangliomas, highlighting the importance of considering paragangliomas in the differential diagnosis of soft-tissue masses of the retroperitoneum.

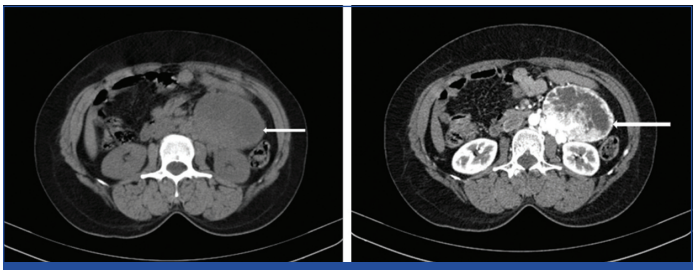
On CT, most abdominal paragangliomas appear as varied soft-tissue masses with heterogeneous hyperenhancement near the inferior mesenteric artery. About 30% of cases can show internal tumour calcifications [5].



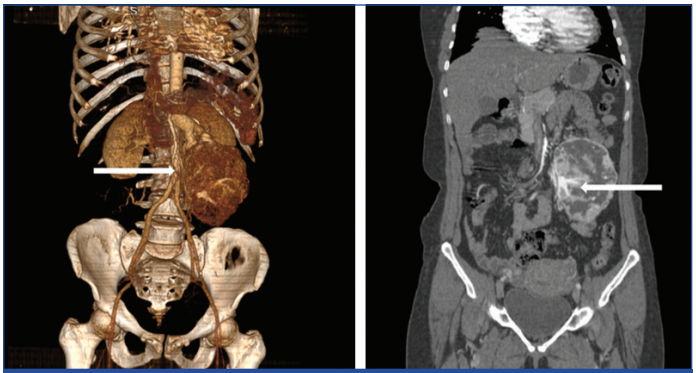
[Table/Fig-10]: Axial section of non contrast study of abdomen shows a well-defined soft-tissue density lesion in the retroperitoneum anterior to the IVC region (Arrow).
[Table/Fig-11]: The postcontrast study reveals heterogeneous enhancement of the lesion and demonstrates the abutment with the IVC and aorta posteriorly and displacement of the mesenteric vessels anteriorly (Arrow).
[Table/Fig-12]: Sagittal postcontrast section showing the indentation of the IVC by the retroperitoneal lesion (Arrow). (Images from left to right)



[Table/Fig-13]: Photomicrograph showing tumour cells arranged in solid nests (indicated by arrows) separated by delicate fibrovascular septae at 10X magnification.
[Table/Fig-14]: Photomicrograph shows polygonal tumour cells having oval to elongated nuclei, and moderate amount of pale eosinophilic granular cytoplasm (Arrow). (Images from left to right)



[Table/Fig-15]: Axial non contrast CT section of abdomen shows a well-defined large soft-tissue density heterogeneous attenuation lesion in the left para-aortic region, posteriorly abutting the left kidney and descending colon (Arrow).
[Table/Fig-16]: Axial postcontrast CT section of abdomen showing intense heterogeneous peripheral enhancement of the lesion with central non enhancing areas (Arrow). The lesion is in the left para-aortic region at the level of origin of inferior mesenteric artery (Organ of Zuckerkandl region). (Images from left to right)



[Table/Fig-17]: A 3D multiplanar reconstruction, frontal view of the abdomen showing the craniocaudal extent of the lesion. The lesion is centered around the region of Organ of Zuckerkandl on the left-side (Arrow).
[Table/Fig-18]: Coronal postcontrast CT section of abdomen showing prominent veins draining the lesion. These veins eventually drain into the left renal vein (Arrow). (Images from left to right)

Factors like tumour size, location, catecholamine profile, and SDHB mutations are important for predicting metastatic risk. Up to 50% of these tumours spread, often to lymph nodes, liver, bones, and lungs [6].

Case 1 presents a large retroperitoneal mass with intense, heterogeneous enhancement. The lesion's intricate relationship with adjacent structures, including the displacement of the duodenum and pancreas, as well as its involvement of the IVC, poses a unique diagnostic challenge. The hepatic lesions with arterial hyperenhancement and venous washout were noted, likely representing metastasis. Multiple skeletal metastases were observed, involving bilateral hip bones and the D10 vertebral body. Additionally, there was also a hyperenhancing lesion in the pancreas that could represent metastasis. These combinations of findings are rare.

A similar case reported by Kadam SS et al., features a heterogeneously enhancing retroperitoneal paraganglioma in the left suprarenal and para-aortic regions, encasing the left renal artery. This lesion also displaced adjacent structures, similar to this case. Additionally, the patient exhibited hepatic metastasis as in this case [7]. In a case report by He J et al., the patient had a large retroperitoneal paraganglioma and multiple skeletal metastases, similar to this case [8]. A case report by Lee S on extra-adrenal mesenteric paraganglioma described similar CT imaging features with the mass being multilobulated in morphology, showing heterogeneous and strong enhancement, consistent with the imaging findings in this case [9].

Case 2 presents a retroperitoneal well-defined heterogeneously enhancing lesion located in the aortocaval region, abutting the IVC with luminal narrowing. The imaging differentials include GIST, extragonadal germ cell tumour, and paraganglioma. The possibility of extragonadal germ cell tumour was excluded as the patient had normal serum beta HCG and AFP levels. In the clinical context of refractory hypertension and elevated urinary catecholamines, the likelihood of an inter-aortocaval paraganglioma was higher than that of a GIST. Surgical resection confirmed the diagnosis of inter-aortocaval paraganglioma and highlights the significance of integrating clinical information with imaging findings.

In a similar case report by Brewster JB and Sundaram CP, a well-defined soft-tissue density lesion was observed in the inter-aortocaval region, showing no invasion into the aorta or the IVC. Similar to the present case, the clinical context of elevated plasma normetanephrine levels was instrumental in making a diagnosis of functional paraganglioma in their case [10].

Case 3 underscores the importance of recognising the Organ of Zuckerkandl region, an uncommon but relevant site for paragangliomas. The lesion's intense enhancement, peripheral washout, and drainage into the left renal vein illustrate the intricate vascular nature of these tumours. Histopathology confirmation reiterates the necessity for a multimodal diagnostic approach. A case report by Najjar R et al., shows a lesion in a similar location at the Organ of Zuckerkandl, displaying heterogeneous postcontrast enhancement, similar to this case [11].

Treatment approaches and challenges: In the management of extra-adrenal abdominal paragangliomas, treatment strategies vary based on tumour size, location, and the potential for metastasis. Surgery remains the primary mode of treatment, aiming at complete resection while preserving vital structures [12]. However,

the anatomical intricacies often pose challenges, especially when tumours are in close relation with critical blood vessels. Precise surgical planning involving a multidisciplinary team is crucial to minimise complications and ensure successful outcomes. Additionally, the potential for intraoperative haemodynamic fluctuations due to catecholamine release during manipulation necessitates careful preoperative management and monitoring. Preoperative alpha blockade followed by beta blockade helps in controlling blood pressure and minimising the risk of hypertensive crisis during surgery.

Radiological considerations: The pivotal role of radiology in the diagnosis and management of extra-adrenal abdominal paragangliomas cannot be overstated. CT imaging, as demonstrated in the present cases, provides essential information regarding tumour location, extent, and vascular involvement. The characteristic enhancement patterns and the presence of calcifications aid in narrowing down the differential diagnosis.

Genetic implications: The hereditary nature of paragangliomas carries significant implications for patients and their families. Genetic testing, particularly for mutations in SDHB, SDHC, SDHD, and VHL genes, is recommended for affected individuals. Identifying genetic mutations not only aids in risk stratification but also influences surveillance protocols, as carriers have an increased likelihood of developing multiple tumours. Early identification, effective management, and genetic counseling play a crucial role in enhancing patient results and shaping future investigations in this domain.

Limitation(s)

While providing valuable insights into the CT imaging characteristics of extra adrenal paragangliomas, the present study has certain limitations. The diagnostic approach primarily relies on CT imaging, a powerful tool; however, the absence of other imaging modalities, such as Magnetic Resonance Imaging (MRI) or functional studies, may pose limitations. Incorporating a multimodal imaging approach in future studies could offer a more comprehensive understanding of these tumours. The present study focuses on CT imaging characteristics and clinical aspects; detailed molecular and genetic analyses were beyond its scope but are crucial for a comprehensive understanding of these tumours. Future studies, with larger cohorts, prospective designs, and a multimodal approach, are warranted to address these limitations and deepen the authors understanding of extra adrenal paragangliomas.

CONCLUSION(S)

The complexities surrounding extra-adrenal abdominal paragangliomas encompass their intricate anatomical relationships, diverse clinical manifestations, and potential for hereditary transmission. The present case series not only contributes to the understanding of the unique CT imaging attributes but also underscores the importance of an integrated approach involving clinical, radiological, and genetic considerations.

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