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Original Research Article

Role of Computed Tomography in Imaging of Retroperitoneal Tumours

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ABSTRACT

Background
This study aimed to assess the various CT imaging results of retroperitoneal tumours and to illustrate the radiological features necessary for a suitable diagnosis.

Methods
Over the course of 18 months, from 1st June 2021 to 1st November 2022, the Department of Radiology at Krishnarajendra Tertiary Care Hospital, which is affiliated with Mysore Medical College and Research Institute, conducted a prospective and descriptive study involving 60 patients who had a clinical suspicion of a retroperitoneal tumour. The study was conducted with the participants' written informed consent and with approval from the institutional ethics committee.

Results
Male patients made up the majority of instances, making up 55% of all cases (33/60), with a male-to-female ratio of 1.2:1. The most typical initial symptom (66.6%) was abdominal pain. The majority of the lesions had malignant content. Out of the 60 instances, 88.33% of the lesions were malignant and 11.66% were benign. Solid lesions made up the majority of the retroperitoneal tumours. Renal lesions were the most common retroperitoneal tumour, with renal cell carcinoma accounting for 31.6% (19/60) of cases. The most prevalent type of enhancement pattern was heterogeneous. The comprehensive assessment of diverse CT imaging results related to retroperitoneal tumours aids in the precise radiologic diagnosis and, consequently, directs the surgical and treatment planning processes.

Conclusion
A comprehensive assessment of multiple imaging findings, including the epicentre of the lesion, tumour composition (solid, cystic, fat, calcification, necrosis), enhancement pattern, tumour size, impact on neighboring organs (displacement or infiltration), vascular encasement, and distant metastasis, is required in order to arrive at an accurate radiologic diagnosis and subsequently inform therapeutic planning.

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Keywords: Computed Tomography, Retroperitoneal Tumours.

INTRODUCTION

One of the biggest and most intricate anatomical regions in the body is the retroperitoneum, where tumours frequently silently grow to enormous sizes even before they manifest clinically.[1] Tumours may have extensive expansion prior to clinical appearance due to loose connective tissue in the retroperitoneum.[2] As a result, prompt and precise diagnosis is essential. It is still challenging to differentiate between retroperitoneal masses that could be soft tissue tumours and to treat them; the appropriate course of action for each patient must be determined individually.[3] CT (Computed Tomography) is the recommended imaging modality among the other imaging modalities for the assessment of retroperitoneal tumours.[4] It helps in treatment planning by being crucial in identifying the tumor's epicentre, size, composition, extent, vascularity, and effects on nearby structures.

USG, CT and MRI

Because USG is low-cost, widely accessible, and non-ionizing radiation-intensive, it is the first imaging modality used. However, due to the size of the tumours, which makes it difficult to accurately determine their epicenter and their relationships to neighboring organs, the evaluation is still lacking. The disadvantages of MRI are its high cost, extended scan times, and restricted availability.

The difference in attenuation between the organs and fat in the retroperitoneum makes CT an excellent method for imaging the retroperitoneum because it improves diagnostic accuracy and aids in the diagnosis of retroperitoneal illnesses.[5] Because macroscopic fat has a measurable attenuation in the region of -10 to -100 HU, computed tomography is very helpful in characterising macroscopic fat. The contrast parameters of CT images are mostly derived from the physical characteristics of tissue.[6] This allows for precise tissue attenuation assessment in conjunction with CT's high spatial resolution. Fat is represented by CT attenuation measures, which are quantitative and range from -10 to -100 HU. Fat is immediately identifiable due to its distinctive visual appearance. The presence of fat within a retroperitoneal lesion is helpful in refining the differential diagnosis.[7] Understanding the anatomy of the retroperitoneum and the imaging features of different retroperitoneal tumours can help restrict the differential diagnosis and provide guidance for clinical therapy.[4,8]

AIMS AND OBJECTIVES

- To illustrate the radiological characteristics of an adequate diagnosis.
- Evaluation of various CT imaging findings of retroperitoneal tumours.

MATERIALS & METHODS

Over the course of 18 months, from 1st June 2021 to 1st November 2022, the Department of Radiology at Krishnarajendra Tertiary Care Hospital, which is affiliated with Mysore Medical College and Research Institute, conducted a prospective and descriptive study involving 60 patients who had a clinical suspicion of a retroperitoneal tumour. The study was conducted with the participants' written informed consent and with approval from the institutional ethics committee.

Inclusion Criteria

Individuals who have lesions that originate from organs located retroperitoneally, such as the pancreas, kidneys, adrenal glands, IVC, aorta, duodenum, ureters, ascending and descending colon, and thoracic oesophagus.

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- Patients presenting as mass per abdomen.
- Patients presenting with abdominal pain and loin pain.
- Incidentally detected lesion in ultrasound.

Exclusion Criteria
- Patients with deranged RFT.
- Patients with a prior history of allergies to contrast agents.
- Pregnant patients.
- Patient not giving consent

Statistical Methods
Microsoft Excel 2016 was used to tabulate and descriptively evaluate the study's outcomes. Tables were used to display the data.

Sample Size
The study comprised 60 patients in total who satisfied the inclusion and exclusion criteria. At the K.R. Hospital Department of Radiology, which is affiliated with the Mysore Medical College and Research Institute in Mysore, a prospective cross-sectional study was conducted.

To describe the retroperitoneal tumour, unenhanced and contrast-enhanced CT scans were performed on each patient. Microsoft Excel was used to tabulate and descriptively analyse the data, which was then displayed in the form of tables. Participants in the study were
of both sexes and all ages.

When possible, relevant investigations, such as histological findings, symptomatology, demographic information, and the history of co-morbidities and diseases, were recorded. A clinical provisional diagnosis was made after the patient provided oral assent.

Image Acquisition and Data Processing
The abdomen and pelvis were computed tomographically using a 128-slice, single-source, dual-energy Somatom Definition Edge Siemens MDCT (Multidetector CT) system. The patients should be taking zero per oral medicine for around six hours before beginning the experiment with normal renal function tests. An intravenous contrast study employing an iodinated contrast agent at a dose of 2 millilitres per kilogramme of body weight was performed after an unenhanced study. Scans were obtained in the course of the portal phase. When required, arterial and delayed images were also acquired.

Over the course of 18 months, from 1 June 2021 to 1 November 2022, a prospective cross-sectional study was conducted at the radiology department of the Krishnarajendra tertiary care hospital, which is affiliated with the Mysore Medical College and Research Institute in Mysore, India. Approved by the Institute Ethics Committee (EC Reg.: ECR/134/Inst/KA2013/RR-19). Patients having either a clinically confirmed retroperitoneal mass or an ultrasound-detected retroperitoneal mass, regardless of age, were included. A comprehensive physical examination and standard blood investigations, such as hemograms, urine analyses, random blood sugar, blood urea, serum creatinine, liver function tests, Hbs Ag, and HIV, were used to gather the clinical history. Exclusions from the trial included patients with unstable general conditions, pregnant women, patients with a history of hypersensitivity to iodinated contrast agents, patients with abnormal renal function tests, and postoperative cases with recurring or residual retroperitoneal tumours.

After receiving their informed written consent, a total of 60 patients were included in

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the study based on the inclusion and exclusion criteria. Using a 128-slice single-source dual-energy Somatom Definition Edge Siemens MDCT (Multidetector CT) system, computed tomography was performed on the abdomen and pelvis.

Prior to the surgery, the patients were instructed to fast for around six hours in order to ensure normal renal function testing. An unenhanced study was conducted first, and then an intravenous contrast study was performed using iodinated contrast agents, such as iopromide (ultravist) or iohexol (omnipaque), at a dose of 2 millilitres per kilogramme of body weight. Scans were obtained in the course of the portal phase. When required, arterial and delayed images were also acquired.

Scanning Protocol

Included was the area between the diaphragm's two domes and the pubic symphysis. Positioning the patient supine with arms over head, the following guidelines were applied: 300 mA, 100 kV, pitch 0.8, 0.5s tube rotation time, 5 mm slice thickness, craniocaudal scan orientation, 45 s scan delay, and 350 mm field of view. In the sagittal and coronal planes, a 1 mm segment was obtained by reconstructing the pictures.

The precise location and origin of retroperitoneal tumours, as well as their magnitude, composition, and enhancing pattern, as well as the displacement of nearby structures, local invasion, vascular encasement, and distant metastases, were all assessed in each examination. Whenever possible, patients were subsequently assessed by biopsy, fine needle aspiration cytology, and/or other surgical techniques for histopathological correlation.

Sample Size Estimation

Using single proportional formula, i.e.

$n = z^2 1\text{-}\alpha/2\ PQ/d^2$

Where,

$z^2_{1-\alpha/2}$ = Two tailed probability for 95% confidence interval = 1.96

P = Prevalence of retroperitoneal tumour, i.e. 36.6%

Q = 100-P = 63.4%

d = Precision =15%

Power of the study = 80%

$n = (1.96)^2\ (36.6)\ (63.4)/(15)^2$

n = 39.2

RESULTS

Age Distribution	Number of Patients	Percentage
0-10y	4	6.66
10-20y	2	3.33
20-30y	1	1.66
30-40y	9	15
40-50y	9	15
50-60y	14	23.33
60-70y	11	18.33
70-80y	9	15
80-90y	1	1.66
Age Distribution		
Gender of Patients	**Number of Cases**	**Percentage (%)**
Males	33	55
Females	27	45

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Sex Distribution
Table 1: Demographic Distribution

The age groups most often affected were the fifth decades. There were sixty patients in all in our study. Of these, there was a majority of men-33 (55%) and 27 (45%) were female.

Clinical Symptoms	Number of Cases	Percentage
Pain abdomen	40	66.6
Loss of weight	24	40
Mass per abdomen	18	30
Loss of appetite	14	23.3
Jaundice	10	33.3
Hematuria	8	13.3
Fever	6	10
Inguinal hernia	1	0.01
Distribution of Clinical Symptoms of the Patients in the Study		
Distribution of Tumours	**Number of Cases**	**Percentage of Cases (%)**
Renal	19	31.6
Adrenal	18	30
Pancreas	11	18.3
Primary retroperitoneal tumour	11	18.3
Periampulllary	1	1.66
Distribution of Retroperitoneal Tumours Based on Organ of Origin in the Study		
Table 2		

The most prevalent clinical complaint was abdominal pain, which might last anywhere from one week to six months. Additional symptoms included inguinal hernia, low-grade fever, hematuria with either frank blood or just a few drops in pee, loss of appetite, weight loss, mass per abdomen, and jaundice. Two or more clinical symptoms were seen in the majority of the cases.

Diagnosis	Number of Cases	Percentage of Cases
Renal Cell Carcinoma	14	23.33
Angiomyolipoma	2	3.33
Mesoblastic nephroma	1	1.66
Renal lymphoma	1	1.66
Wilms tumour	1	1.66
Distribution of Renal Lesions in the Study		
Diagnosis	**Number of Cases**	**Percentage**
Adrenal adenoma	2	3.33
Pheochromocytoma	3	5
Paraganglioma	3	5
Neuroblastoma	2	3.33
Adrenal Myelolipoma	1	1.66
Adeno cortical tumour	1	1.66
Adrenal metastasis	8	13.33
Distribution of Adrenal Lesions in the Study		
Table 3		

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Renal lesions (19 cases) and adrenal lesions (18 instances) were the two types of malignancies that were most prevalent. Kidney cell carcinoma accounted for 14 instances of all kidney cancers, making it the most frequent type.

Lung cancer was the main tumour in each of the three adrenal tumour cases, with metastases accounting for eight of the tumours.

Diagnosis	Number of Cases	Percentage
Retroperitoneal lymphoma	4	6.66
Primary retroperitoneal liposarcoma	4	6.66
Pre and para aortic lymph nodes	2	3.33
Lymphangioma	1	1.66
Distribution of Primary Retroperitoneal Lesions in the Study		
Diagnosis	**Solid/Cystic**	**Number of Cases**	**Percentage of Cases**
Malignant lesion in head of pancreas	Solid	5	8.33
Malignant lesion in body of pancreas	Solid	4	6.66
Malignant lesion in tail of pancreas	Solid	1	1.66
Malignant lesion with involvement of entire pancreas	Predominantly cystic with few solid components	1	1.66
Distribution of Pancreatic Lesions in the Study			
Table 4			

Eleven cases of primary retroperitoneal tumours were included. The most frequent primary retroperitoneal tumours were liposarcoma and lymphoma, each with four instances, and lymph node metastases, with two cases. One incidence involved a lymphagioma.

Eleven instances showed signs of pancreatic lesions. In five cases, the lesion was found in the pancreatic head, four in the body, one in the tail, and one in which the gland was diffusely involved. One case had cystic lesions with a solid component, and the other ten cases had solid lesions with heterogeneous enhancement. The pancreatic body and head were the areas most frequently affected. In nine of the eleven instances, pancreatic ductal adenocarcinoma was found. One example was a neuroendocrine tumour that involved the pancreatic tail. Serious cystadenocarcinoma was one of the cases.

Nature of the Tumour	Benign	Malignant
Number of cases	7	53
Percentage (%)	11.66	88.33
Table 5: Nature of Lesions in the Study		

The patients ranged in age from 5 days old for the youngest to 82 years old for the oldest, with a mean age of 61 years. Of the lesions, 53 cases (88.33%) had malignant lesions, while seven instances (11.66%) had benign lesions.

Characteristics of Tumour	Category	Number of Cases	Percentage
Size	<10 cm (in greatest diameter)	49	81.66
	>10 cm (in greatest diameter)	11	18.33
	Perirenal spaces	38	63.33

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	Anterior pararenal space	11	18.33
Epicenter of the tumour	Periampullary region	1	1.66
	Pre and para aortic regions	7	11.66
	Paraspinal regions	3	5
Tumour composition			
1. Nature of lesion	Solid	59	98.33
	Cystic	1	1.66
2. Fat	Present	11	18.33
	Absent	49	81.66
3. Calcification	Present	9	15
	Absent	51	85
4. Necrosis in solid tumours	Present	20	33.33
	Absent	40	66.66
	No enhancement	2	3.33
	Homogenous enhancement	8	13.33
Enhancement pattern	Heterogenous enhancement	43	71.66
	Intense enhancement	6	10
	Hypoenhancement	1	1.66
Effect on adjacent structures			
1. Displacement of	Present	27	45
adjacent organ	Absent	33	55
2. Infiltration of adjacent	Present	11	18.33
organ	Absent	49	81.66
3. Vascular encasement	Present	19	31.66
	Absent	41	68.33
Distant metastasis	Present	9	15
	Absent	44	73.33
Benign vs Malignant	Benign	7	11.66
	Malignant	53	88.33

Table 6: Various Imaging Characteristics of Retroperitoneal Tumours in the Study

In our investigation, the largest tumour dimension was less than 10 cm in 49 cases and more than 10 cm in 11 cases. The most frequent epicentre of the malignancies (38 instances) was involvement of the perineurial region. There was just one cystic tumour out of the 59 cases where solid tumours predominated. Twenty cases had necrosis, nine had calcification, and eleven had areas of fat attenuation. 43 cases had heterogeneous enhancement, 8 had homogeneous enhancement, and 2 had no enhancement at all. Heterogeneous enhancement was the most prevalent form of enhancement. There were 27 occurrences of neighbouring organ displacement and 11 cases of adjacent organ infiltration. Nine instances had distant metastases, while 19 cases showed vascular encasement.

Of the 60 cases, 49 had a histology correlation that could be determined, and in all 49 of those cases, the tumours' CT diagnoses correlated with the histopathological results.

DISCUSSION

CT is essential for characterising retroperitoneal cancers since it can determine the tumor's location, origin, extent, composition (fat, calcification, and necrosis), enhancing pattern, effect on neighbouring tissues, and distant metastases. The unique imaging results can help narrow the differential diagnosis, which can help with treatment planning.[8]

Thirty-seven (43.3%) and thirty-three (56.6%) of the sixty patients in our study were

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female. Eighty-eight was the oldest patient's age, while five days was the youngest. Of the 60 cases, 53 (88.33%) had malignant lesions and 7 (11.66%) had benign lesions. Malignant lesions were more common than benign lesions. Similar findings were obtained by studies conducted by Chaudhari et al.[9] and Stephens et al.[10] had fewer benign patients than did our analysis. This is because, although 10 malignant recurring cases were included in the Stephens et al. study, no recurrent cases were included in our analysis. The findings of the two aforementioned studies indicate that CT is a valuable diagnostic tool for retroperitoneal tumours and their recurrences. CT scan data is vital for developing a rational treatment strategy, even in cases where the cancer is advanced.

In our analysis, renal masses constituted 31.66% (19/60) of the maximum cases. The most common lesion was renal cell carcinoma. RCCs (Renal Cell Carcinomas), the most common adult epithelial malignancy, were shown to be 90% of renal tumours in a research by Cupido BD, Sam M, Winters SD, et al.[11] that produced similar findings. Clear cell tumours accounted for 70% of RCCs, making them the most common subtype. Comparable findings were obtained from our investigation.

The presence of fat and calcification in retroperitoneal tumours significantly narrows the range of potential diagnoses. There were areas of fat attenuation within the lesion in eleven of the cases in our analysis, seven of which were benign and four of which were malignant. Fat was therefore more likely to be present in benign lesions. Similar results were observed in the study by Bosniak et al.[12] which stated that the only radiologic finding that can distinguish angiomyolipoma from renal cell carcinoma is the presence of fat in the renal lesion, which is how angiomyolipoma is identified. The main feature that separates benign from malignant adrenal tumours is the presence of significant intracellular cytoplasmic lipids. Adrenal adenoma and myelolipoma both exhibited areas of fat attenuation. Thirteen necrosis is a noteworthy observation that is commonly seen in malignant tumours and presents as modest attenuation without contrast enhancement. Twenty instances in our study had necrosis; of these, eighteen were malignant and two were benign, including paraganglioma and pheochromocytoma. RCC (Renal Cell Cancer) showed up on a plain scan as a low-density area with uneven post-contrast enhancement and central necrosis. Necrosis was observed in every RCC case, while calcifications were observed in 33.3% of the cases. Similar results were observed in investigations by P. Hatimota et al., which demonstrated that necrosis was detected in 94% of RCC cases, and Zagoria et al.,[13] which indicated that calcifications were apparent in 31% and necrosis was observed in 87.5% (7/8) of cases.

Another characteristic of a malignant tumour that affects the tumor's surgical resectability is vascular encasement. All 19 of the patients in our study with vascular encasement had malignant tumours, including neuroblastoma, renal cell carcinoma, periampullary carcinoma, and lymphoma. Similar results were observed in the study by Lee ES et al.[14] which revealed that multidetector CT is the most effective method for assessing vascular involvement, which is a critical element in determining whether the tumour can be surgically resected.

One case of lymphangioma, which was the only cystic lesion in our study, showed up as a multiloculated hypodense lesion that didn't enhance and lost fluid. Similar results were also observed in the work of Hayasaka K et al.[15] which reported fluid attenuation in lymphangiomas.

Two instances of neuroblastoma with a median age of 1.5 years were included in our investigation, and one of the cases had intrathoracic extension. Hugosson C. et al.[16] research, published in 2016, examined 31 infants with abdominal neuroblastomas who had CT and USG scans at a median age of two years. They found that MRIs and CT scans performed better than ultrasounds. The evaluation of the location or size of a tumour using

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CT and MRI does not significantly differ from one another. Using MRI, intraspinal extension was shown more clearly. They came to the conclusion that, while CT was superior for assessing the metastatic disease, MRI or CT was best for assessing the local disease. Therefore, imaging could be useful for preoperative staging and clinical evaluation of abdominal neuroblastomas.

One of our study's limitations was that in 11 individuals with adrenal lesions, histological association could not be determined. One case with a CT diagnosis of pheochromocytoma was not subjected to biopsy due to the risk of hypertensive crises; however, the urinary catecholamines were elevated. The coagulation profile was altered in the remaining cases.

CONCLUSION

The retroperitoneum is one of the body's more complex anatomical regions, and tumours arising from it can be challenging for radiologists to diagnose. This study aimed to identify the different imaging characteristics of retroperitoneal tumours and to employ CT as an imaging modality to aid in the radiologic diagnosis. The collaborative assessment of multiple imaging findings, including the epicentre of the lesion, tumour composition (solid, cystic, fat, calcification, necrosis), enhancement pattern, tumour size, effect on neighbouring organs (displacement or infiltration), vascular encasement, and distant metastasis, facilitates accurate radiologic diagnosis and subsequent therapeutic planning.

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