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Comparison of Contrast Enhanced Computed Tomography with Contrast Enhanced Magnetic Resonance Imaging for Evaluation of Retroperitoneal Mass Lesions

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Abstract:
Background: *Retroperitoneal mass lesions are one of the common pathologies encountered in radiological practice. Once considered to be a chiefly pathological diagnosis with radiology taking a supplementary role in evaluating disease location and extent, it is now accepted that radiology does play an important role in primary diagnosis of retroperitoneal lesions. Computed tomography (CT) is often the first investigation patients with retroperitoneal pathologies undergo, followed by magnetic resonance imaging (MRI). MRI is traditionally considered a second line supplementary investigations which helps in tissue characterisation and invasive features. However, due to wider availability, MRI is now being utilised more often as a first line investigation. We have selected this study to evaluate and compare the efficacy of both MRI and CT in diagnosis of retroperitoneal mass lesions.*
Materials and methods: *In this study, 50 patients of all age groups who presented with clinical signs and symptoms pertaining to retroperitoneal pathology and who had suspected primary retroperitoneal neoplastic lesions or neoplasms originating from retroperitoneal organs and lymph nodes on ultrasound were selected to undergo CECT and CEMRI. Diagnosis from both modalities were compared with final pathological diagnosis to evaluate effectiveness of each.*
Results: *There were 3 (7%) pathologically malignant lesions which were misdiagnosed as benign lesions on MRI. There were no pathologically benign lesions which were misdiagnosed as malignant lesions on MRI. There were 5 (11.63%) pathologically malignant lesions which were misdiagnosed as benign lesions on CT. There were 2 (25%) pathologically benign lesions which were misdiagnosed as malignant lesions on CT.*
Conclusion: *Both CECT and CEMRI play an important role in evaluation of retroperitoneal lesions with the former having the advantage of wider availability, lower scan times and better evaluation of bones and calcifications while the latter having the advantage of better tissue characterisation and evaluation of invasive features.*
Key Word: *CECT, CEMRI, retroperitoneal neoplasm, retroperitoneal malignancy, CT vs MRI*

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I. Introduction

CT and MRI are important for diagnosis and evaluation of extent of retroperitoneal mass lesions. This helps in determining treatment outcomes. MRI is the best imaging tool available for assessing soft tissue contrast, which is especially useful for staging and assessment of vascular invasion. MRI also has the benefit of no ionizing radiation. MDCT is quicker with wider availability and gives accurate diagnosis with multiplanar and volumetric reformation. Both modalities provide important information to the managing doctor which will help in assessing further management.

II. Material and Methods

This is a prospective study was carried out in the department of radiodiagnosis and imaging at Guru Gobind Singh government hospital, Jamnagar from 2018 to 2021.
Study Design: Prospective study
Study Location: This was a tertiary care teaching hospital-based study done in Department of Radiodiagnosis, at M.P. Shah medical college and G.G. government hospital, P.N. marg, Jamnagar, Gujarat.
Study Duration: May 2018 to January 2021
Sample Size: 50 patients
Subjects & selection method: The study population was drawn from all patients presenting with clinical features and signs as well as ultrasound suspicions pertaining to retroperitoneal pathology. Routine blood investigations were documented in patients who required them – complete hemogram, which includes

haemoglobin, total and differential white blood cell count, erythrocyte sedimentation rate and serum creatinine level.

Inclusion criteria:

1. Patients are selected for this study who presented with clinical symptoms and signs pertaining to retroperitoneal pathology.
2. Patients who had suspected retroperitoneal neoplastic lesions on ultrasound.

Exclusion criteria:

1. Patients with a cardiac pacemaker in situ.
2. Patients with metallic implants in situ.
3. Claustrophobic patients
4. Patients who refuse consent.

Procedure methodology

After written informed consent was obtained, a well-designed questionnaire was used to collect data of the recruited patients. The questionnaire included socio-demographic characteristics such as age and gender and clinical symptoms and routine blood investigation results. Patients were then subjected to CECT and CEMRI examinations.

Imaging technique:

Computed tomography of abdomen-

Preparation of patient:

- Minimum 6 hours of nil-by-mount fasting.
- Bowel preparation was done by giving two tablets of lactulose overnight.
- Multiphase CT scan of abdomen and pelvis was performed which included a plain scan followed by a post contrast study including arterial, venous and delayed phase imaging.
- A 20/22 G intravenous catheter was inserted in the anterior cubital vein for giving intravenous contrast under personal observation by anaesthetist.
- Non-ionic contrast (Omnipaque 350mg%) was used in a dose of 1 ml/kg body weight and contrast administered after taking a plain scan, at a rate of 3 ml/s by a pressure injector.
  CT studies were performed on a DUAL SOURCE CT SCANNER (Bright speed, GE healthcare, 16 slice machine, UK) in all patients. All axial, coronal and sagittal reconstructions were performed.
  Magnetic resonance imaging of abdomen
- After completing CT scan, patients were taken for MRI study immediately.
- Most patients were placed in the supine position for MR imaging. This position reduces the area to be imaged and may help elevate bowel loops and separate them from the pelvis.
- Gadopentate demeglumine was used as IV contrast medium.
- All MR imaging examinations were performed at our institutions by using a 1.5T MR imaging system (Magnetom essenza; Siemens Healthcare, Germany) and two six-channel phased-array abdominal coils.
- We applied various pulse sequences in combination, to compensate for the limitations of individual sequences. Chemical shift artefact was sometimes seen on images obtained with steady-state precession sequences complicated the assessment of bowel wall thickness; however, mesenteric vessels and lymph nodes were well depicted.
- Fast or turbo spin-echo sequences that are based on the half-Fourier reconstruction technique help limit or overcome movement artefacts. They produced high contrast, providing excellent depiction.
- Results were be checked by two radiologists (PI and CO-PI) and final comparative data was given between computed tomography and magnetic resonance imaging with counting risk factor of ionising radiation and intravenous contrast toxicity.

III. Observation and Result

Table 1: Distribution of benign, malignant, and metastatic lesions

	No. of cases	Percentage (%)
Benign	8	16
Malignant	30	60
Metastasis	12	24
Total	50	100

In our study, malignant lesions were most common retroperitoneal lesions observed, seen in approximately 60% of the study population. Total percentage of malignant lesions (Neoplastic and metastatic) was even higher at 84%.

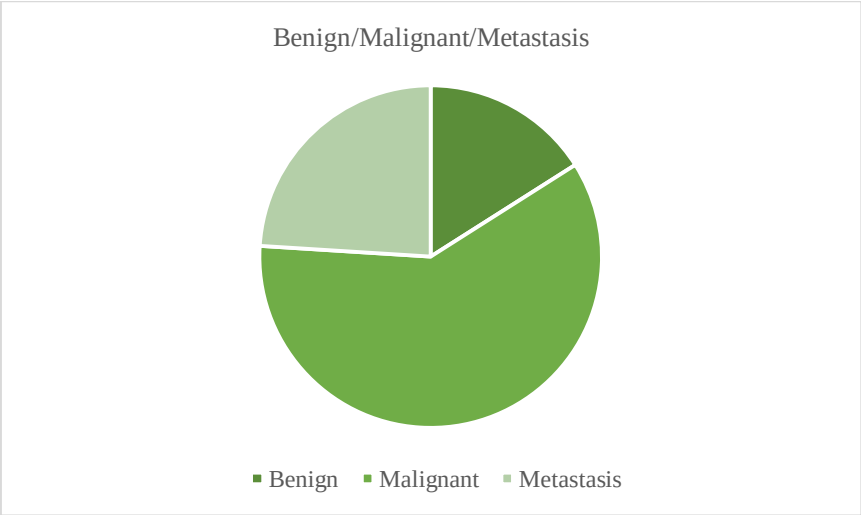


Table-2: Distribution of benign, malignant, and metastatic lesions in retroperitoneal neoplasms

Organ of Involvement	**Benign**		**Malignant**		**Metastasis (#)**	
	No. of cases	Percentage (%) *	No. of cases	Percentage (%) *	No. of cases	Percentage (%) *
Adrenal gland	2	3.92	1	1.96	5	9.8
Pancreas	1	1.96	9	17.6	3	5.88
Kidney	3	5.88	5	9.8	3	5.88
Ascending colon	0	0	2	3.92	0	0
Descending colon	0	0	2	3.92	0	0
Duodenum (2nd and 3rd part)	0	0	2	3.92	0	0
Lymph nodes	0	0	4	7.84	2	3.92
Primary retroperitoneum	2	3.92	5	9.8	0	0
Total	8	15.7	30	58.8	13	25.5

* Includes percentage of cases of the total number of the retroperitoneal lesions.
# This does not include metastases from other primary retroperitoneal neoplasms.

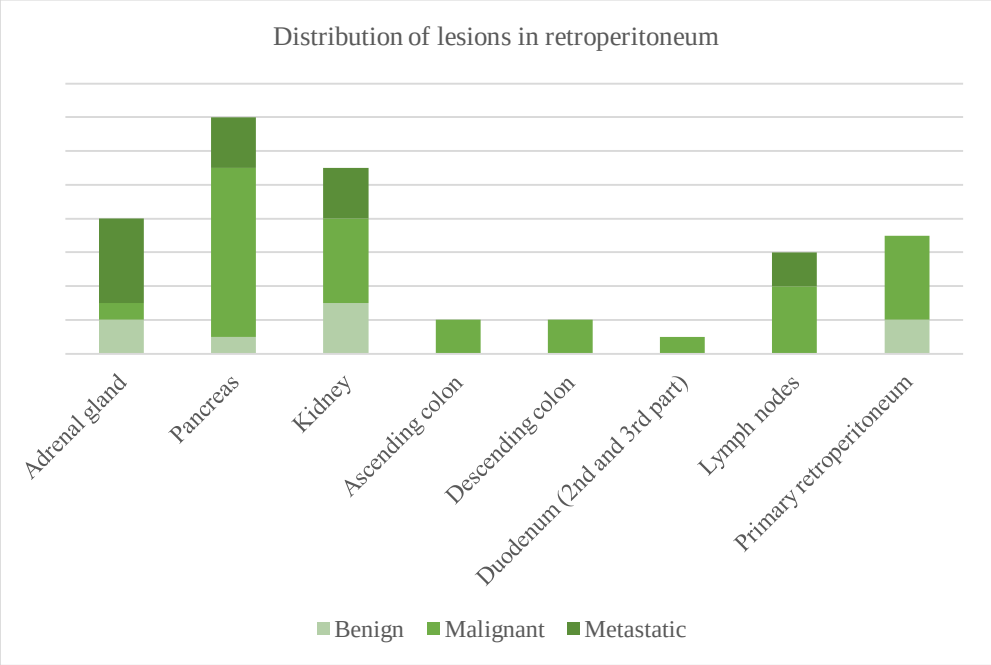
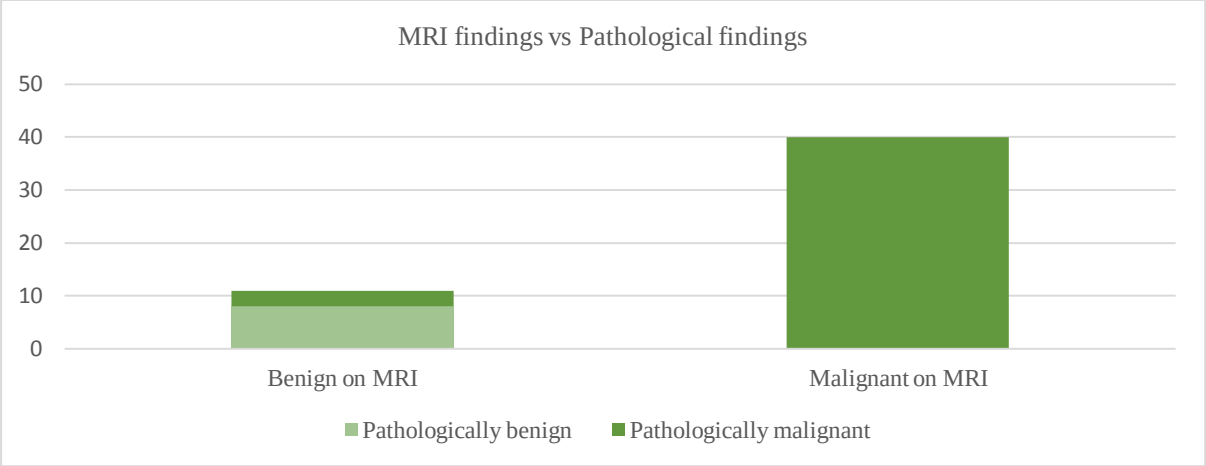


Table-3: Comparison of MRI findings versus pathological findings

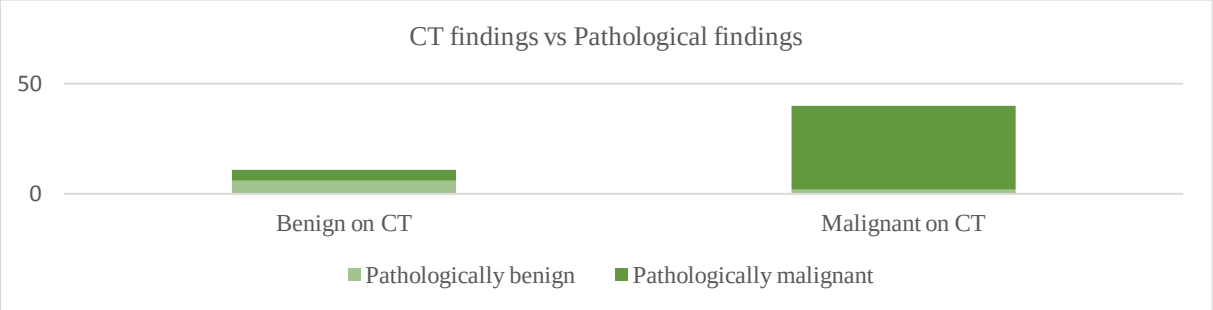
Number of cases	**Pathologically benign**	**Pathologically malignant**
Benign on MRI	8 (100%)	3 (7%)
Malignant on MRI	0	40 (93%)
Total	8 (100%)	40 (100%)



There were 3 (7%) pathologically malignant lesions which were misdiagnosed as benign lesions on MRI. There were no pathologically benign lesions which were misdiagnosed as malignant lesions on MRI.

Table-4: Comparison of contrast enhanced CT findings versus pathological findings

Number of cases	**Pathologically benign**	**Pathologically malignant**
Benign on CT	6 (75%)	5 (11.63%)
Malignant on CT	2 (25%)	38 (88.37%)
Total	8 (100%)	43 (100%)



There were 5 (11.63%) pathologically malignant lesions which were misdiagnosed as benign lesions on CT. There were 2 (25%) pathologically benign lesions which were misdiagnosed as malignant lesions on CT.

IV. Discussion

Primary retroperitoneal malignant and benign lesion

According to Giovanni C. et al, primary retroperitoneal tumors (PRT) include masses that originate in the retroperitoneal space, independently of the organs present therein. Of the primary retroperitoneal neoplasms, 62-86% are malignant in nature.

In present study, there were 11 cases of primary retroperitoneal neoplasm (inclusive of lymphoma arising from lymph nodes) of which 9 were malignant and only 2 benign lesions.

Primary retroperitoneal	**Present study**	**Giovanni C. et al[1]**
Malignant (%)	81.8%	62-86%
Benign (%)	18.2%	14-38%

As seen in the above table, the findings in present study were in congruence with Giovanni et al.

Primary retroperitoneal sarcoma

Solid neoplasm in the retroperitoneum can be broadly divided into four groups:

a) Mesodermal neoplasms
b) Neurogenic tumors
c) Germ cell, sex cord and stromal tumors
d) Lymphoid and hematologic neoplasms

Liposarcoma is the most common primary retroperitoneal sarcoma (70%) while leiomyosarcoma is the second most common (15%)[1]. In our study we had one case of primary retroperitoneal leiomyosarcoma involving the IVC.

	Present study	**Hartman DS et al[2]**
Age at presentation	6th decade	5th-7th decade
Gender	Female	Female>male
Most common subtype	Vascular	Extravascular
Areas of necrosis	Present	Present when large
t1WI	Hypointense	Hypointense
t2WI	Hyperintense	Hyperintense
Compression over adjacent organs	Present	Commonly observed in large tumors
Areas of internal haemorrhage	absent	Rare

Desmoid Tumor

Aggressive fibromatosis or desmoid tumor is an infiltrating fibroblastic proliferation arising from the musculoaponeurotic structures.

	Present study	**Marta et al[3]**
Age at presentation	28 years	3rd-4th decade
Gender	Female	Female>male

CT	Hyperdense to muscle	Hyperdense to muscle
CECT	Hyperenhancing to muscle	Hyperenhancing to muscle
t1WI	Hypointense	Hypo to isointense
t2WI	Hypointense	Variable
Compression over adjacent organs	Present	Commonly observed in large tumors

In our study, we had one case of retroperitoneal desmoid tumor, a 28-year-old female presenting with complaint of left sided hip pain. She underwent ultrasound which detected a mass lying within pelvic cavity and was suggested CT. CT showed a large extraperitoneal mass indistinguishable from iliacus and iliopsoas. MRI showed a large mass invading iliacus and iliopsoas and involving lumbosacral plexus. Ultrasound guided biopsy confirmed it to be desmoid tumor.

Ganglioneuroma

Ganglioneuroma (GN) is a rare benign tumor, its either happens spontaneously or during the therapy for neuroblastoma with either chemotherapy or radiation therapy. Association with Turner's syndrome and multiple endocrine neoplasia II has been reported[3].

	Present study	**Xiaolu Wang et al[4]**
CT	Hypoattenuating	Hypoattenuating
t1WI	Hypointense	Hypointense
t2WI	Hyperintense	Hyperintense
Clinical features	Asymptomatic	Usually asymptomatic

In our study, we had one case of retroperitoneal ganglioneuroma, a 19-year-old male underwent ultrasound for right sided renal calculus which detected said calculus and also a mass lying upper retroperitoneum was suggested CT. CT showed a hypodense retroperitoneal mass without invasion of surrounding organs. MRI was done and benign aetiology of mass was suggested. Ultrasound guided biopsy confirmed it to be ganglioneuroma.

Characteristics of angiomyolipoma (AML)

	Present study	**Craig WD et al[5]**
Subtypes	Sporadic	Sporadic or associated with tuberous sclerosis
Unilateral/Bilateral	Unilateral	Bilateral when associated with tuberous sclerosis
Single/Multiple	Single	Multiple in tuberous sclerosis
Most common site	Kidney	Kidney
Other organs affected	None	Other solid organs, retroperitoneum
Homogeneous/Heterogeneous	Homogenous	Homogeneous when small sized, heterogeneous when large
Enhancement on CECT	Hyperenhancing	Hyperenhancing
T1WI MRI	Hyperintense	Hyperintense
T2WI MRI	Intermediate	Hyperintense
Areas of internal haemorrhage	Absent	Present when large

AMLs are found in upto 80% of individuals with tuberous sclerosis, and while the tumors are histologically identical to the sporadic form, they are more often multiple, bilateral, and present in younger patients. Patients with tuberous sclerosis account for 20% of cases of AML.[5]

Lymphoma

Lymphoma is the most common retroperitoneal malignancy. Lymphoma can be broadly divided into Hodgkin's lymphoma and non-Hodgkin's lymphoma. Hodgkin's lymphoma has a bimodal age distribution, occurring in patients in their 20s and 60s, and manifests with limited disease, often involving the mediastinum and spleen.

	Present study	Neville A. et al[6]
Lymphoma (%)	70%	30%

In present study, there were 10 cases of primary retroperitoneal neoplasm, of which 7 cases were of primary lymphoma, 4 cases were of Hodgkin's lymphoma and 3 cases of Non-Hodgkin's lymphoma. Thus, in our study, the most common retroperitoneal malignancy was lymphoma.

Age distribution of non-Hodgkin's lymphoma

Non-Hodgkin's lymphoma is seen in the 40-70-year age group and frequently manifests with extranodal disease in the liver, spleen, or bowel, often at an advanced stage. Mesenteric lymph nodes are also more commonly involved in Non-Hodgkin's lymphoma. At CT, lymphoma is seen as a well-defined homogeneous mass, with mild homogeneous contrast enhancement. At MR imaging, lymphoma is usually isointense on T1 weighted images and iso to hyperintense on T2 weighted images.

	Present study	Neville A. et al[6]
Non-Hodgkin's lymphoma	50-80	40-70

The different age presentation of 3 cases of Non-Hodgkin's lymphoma were 55, 75 and 80. One of them (female, 80 years) had diffuse mesenteric lymphadenopathy and was more invasive causing invasion of pancreas, duodenum and causing encasement of aorta and most of its branches and corresponding veins as well. One of them (male, 55 years) presented in the form of diffuse metastases involving bilateral kidneys and adrenal glands associated with vertebral and scapular metastases. In both these cases the lymph nodes were heterogeneous and showed heterogeneous enhancement. Rest two cases showed diffuse lymphadenopathy involving inguinal, axillary, mediastinum, hepatosplenomegaly with splenic infiltration and hepatosplenomegaly with axillary lymphadenopathy.

Involvement of inferior vena cava in adrenocortical carcinoma

	Present study	Chiche L et al[7]
IVC thrombosis	Present	Present

Chiche L et al reported that invasion of the IVC was a well-known complication of adrenocortical carcinoma. In one series of 15 adrenocortical carcinomas that invaded the IVC, 12 were on the right side. Also presented in that article was that the highest level of venous extension in 51% of patients was suprahepatic IVC among those for whom this information was provided.

In present study, there was one case of adrenocortical carcinoma, 46 years old male who had abdominal lump and came to hospital with accidental trauma. On imaging, a large right sided suprarenal adrenal mass of size (9 x 8) cm was present causing posterior displacement of kidney and anterior displacement of pancreas. Extensive venous thrombosis involving inferior vena cava was observed superiorly extending up to middle hepatic vein and inferiorly involving bilateral iliac veins.

In our study, 50 cases of retroperitoneal neoplastic lesions were evaluated in relation to the clinicopathological profile and previous imaging studies. Attempts were made to correlate these findings with each other and other pathological and surgical findings.

Computed tomography (CT) and magnetic resonance (MR) imaging play an important role in characterization (size, shape, wall thickness, septa, calcification, and fat content) and the assessment of the extent of the disease and involvement of adjacent and distant structures[8, 9, 10]. Although CT is better for assessing calcification than MR, MR has superior soft tissue contrast, as well as for evaluating the fat content of lesions. For evaluation of cystic lesions, MRI has better sensitivity than CT. Contrast enhanced CT is better modality than non-contrast MRI to assess for vascular invasion. Although a specific diagnosis might be difficult to determine because of overlapping imaging appearances, the identification of certain characteristic imaging features, along with clinical and demographic information, may help in narrowing the differential diagnosis. For a suspected hyperfunctioning neoplasm, CT and MRI finding when correlated with appropriate biochemical examinations aids us a lot to come to conclusion. For evaluation of intracellular fat, chemical shift MR imaging is especially useful and helps us to easily differentiate between a benign and malignant lesion. Enhancement characteristic on CT aids us a lot in knowing the nature of neoplasm, like hypervascular lesions show intense enhancement. Heterogeneous and high enhancement is mostly seen in malignant neoplasm. On CT and MR, we can very well know the shape and contour of neoplasm and this helps us in very well differentiating the neoplasm. For example, the ball versus bean strategy is a useful framework for analysing the imaging characteristics of renal masses. Its basic principles apply not only to CT but also to MR and sonography. When faced with the bewildering array of pathologic conditions that can assail the kidney, ball versus bean offers a starting point. CT and MR imaging are excellent modalities for the initial detection as well as characterization of

cystic pancreatic lesions. The classification of cystic pancreatic lesions based on their imaging morphologic features can simplify the differential diagnosis and be of value in management. For evaluation of biliary tree and obstructive biliopathy, MR is an extremely sensitive tool and is better modality than CT. This also applies for the evaluation of pancreatic duct. Multidetector CT studies performed with coronal and sagittal reformations fully delineate the peritoneal anatomy and extent of disease. Since understanding the anatomic relationships and pathologic processes of the peritoneum is essential to provide accurate diagnosis.

V. Conclusion

Considering all the parameters and pros and cons of each modality, overall, contrast enhanced MRI is better in characterization and in narrowing the diagnosis of retroperitoneal neoplasm than contrast enhanced CT but contrast enhanced CT is a better first line investigation of choice.

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