Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://dx.doi.org/10.21608/zumj.2021.77165.2241 Volume 29, Issue 2, March 2023, Page (525-531)
Manuscript ID ZUMJ-2105-2241 (R1)
DOI **10.21608/zumj.2021.77165.2241**

ORIGINAL ARTICLE

The Role of Multidetector Computed Tomography in Characterization and Differentiation of Retroperitoneal Masses.

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Submit Date 2021-05-24
Revise Date 2021-06-22
Accept Date 2021-07-01

ABSTRACT

Background: This study aimed to assess the accuracy of multi-detector computed tomography (MDCT) in the diagnosis of different retroperitoneal masses by comparing with the pathology results of the studied cases. Cases of suspected retroperitoneal masses by ultrasound, MDCT is the reference standard for them, it shows up the accurate diagnosis, location, extent of the tumor, along with the involvement of adjacent organs and vessels. It also has high accuracy in the differentiation of malignant from benign lesions, detection of lymph node involvement & metastasis. Therefore, MDCT plays an important role in treatment planning and follow-up of different retroperitoneal masses. MDCT has many Advantages over other imaging modalities: less invasive, more widely available, lower dose of radiation, higher spatial & temporal resolution

Methods: This study was carried out at Radiodiagnosis Department, Zagazig University Hospitals, and other radiological centers. The present study was carried on 42 patients with retroperitoneal masses. Those patients were examined by MDCT.

Results: The MDCT images of 42 patients were analyzed for reaching the final diagnosis. The results of MDCT were compared with the histopathological results. Positive results were obtained in 37 lesions out of a total of 42 cases, with estimated CT accuracy of about 88.1% in the diagnosis of different retroperitoneal masses.

Conclusions: MDCT should be used in the first place in the course of diagnostic and staging procedures of patients with different retroperitoneal tumors and tumor recurrence.

Keywords: Multidetector; CT; Retroperitoneal masses, benign, malignant.

INTRODUCTION

The anatomical retroperitoneal space is a complex one. It includes solid and hollow organs, as well as lymphatics, lymph nodes, major vessels, and stromal tissues. Numerous neoplastic and non-neoplastic masses can occur in the retroperitoneal space. Retroperitoneal mass diagnosis at imaging is a challenging task for radiologists, who depend on a combination of clinical, laboratory, and imaging features to put a list of differential possibilities [1].

The majorities of retroperitoneal masses arise from retroperitoneal organs and are therefore not considered primary retroperitoneal masses. Diagnosis of a primary retroperitoneal mass could also be made once the situation is confirmed as within the retroperitoneal space and after an organ of origin is excluded [2].

Computed tomography (CT) is that the preferred modality in imaging of the retroperitoneum. The diagnostic accuracy of CT for detection of retroperitoneal diseases depends on the attenuation differences between retroperitoneal fat and organs [3]. CT plays a very important role within the characterization of those masses and therefore the evaluation of their extent and involvement of nearby structures, and treatment planning [4]. The advantages of Multi-Detector CT (MDCT) include quicker scanning, increased volume coverage, and improve spatial & temporal resolution [5].

METHODS

This study was carried out at radiology department and other radiological centers from April 2020 to October 2020 on 42 patients; from 4 months to 81 years old with (mean age was 41.5 years ± 22.8). 24 females and 18 males were taken as a comprehensive sample, at the speed of seven cases/ month. The patients were referred from general

surgery, oncology, and urology departments of Zagazig University Hospitals, likewise to the outpatient clinics to perform MDCT study with IV contrast for clinically or ultrasound, suspected retroperitoneal masses.

Written informed consent was obtained from all participants, the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The study was done according to the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. We took history from all patients, revise all previous investigations especially renal function tests, then we did MDCT examination of the abdomen and pelvis and we correlated histopathological reports to our imaging reports.

Patient preparation:

Patient laboratory data were initially revised with a specific interest within the results of the renal function tests. We instruct all patients to prevent solid food intake for 4-6 h before examination and to continue adequate simple fluid intake up to three hours former to examination to make sure adequate hydration

Sedation

Patients below 4 years or who are in-cooperative were sedated by a special anesthetist using orally administered depressant (50-100mg/kg; maximum dose, 2000mg) and IV administered Phenobarbital sodium (6mg/kg; maximum dose 200 mg). In older children and adult patients who responded to verbal reassurance, sedation was not indicated.

Contrast administration:

We placed an appropriate size 18-20 gauge catheter into the antecubital fossa where an intra-vascular non-ionic contrast agent (Ultravist 370) was injected. Power injector administer of IV contrast media was employed, the whole volume of contrast is administrated at a rate of 1ml/s for younger children to 3ml/s for older children and adult patients.

Scan protocol and parameter:

CT scanning: All studies were performed using 128 slice MDCT (Phillips inguinty). We did CT abdomen and pelvis with oral and IV contrast to the patients using the subsequent parameters; (350 mA, 120 KV, 0.5 second tube rotation time, slice thickness 5 mm, 8 mm table feed &3 mm incremental reconstruction, scan area extend from diaphragm to the pubic symphysis with the patient lying supine). Scanning parameters for children: were considered by adjusting the highest kilovoltage and tube correct setting milliampere seconds (MAS) to attenuate the radiation dose delivered as low as possible; (Kvp: low dose protocol 80-110 KV tube voltage, MAS: weight adapted setting for tube current (60 MAS/ Rotation for patients 5 kg body, 60-79 MAS/ Rotation for patient quite 10 kg weight, 80-120 MAS /rotation for patients more than 10 kg body weight). Non-contrast CT was employed in patients with impaired renal function (creatinine level >2 mg/dL) and/or have a history of hypersensitivity for contrast media.

Post-procedure assessment

The peripheral venous line is removed. We kept the patient under observation for 15minutes after the procedure if was sedated, till recovery.

Volumetric data analysis

All images were sent to the workstation (PHILIPS Intellispace) for post-processing. The principle technique used for volumetric imaging analysis were MPR, two & three-dimensional reformation with volume rendering (VR).

Image interpretation:

We examine cases (by 2 radiologists) using an axial, sagittal, and coronal image, MPR& VR when needed. Then we compared the final clinical diagnoses reached to the surgical /histopathological results.

Statistical analysis:

Statistical analysis was done using SPSS software version 25 (IBM, 2017). Data were presented in tables and figures. Continuous data were presented as mean, standard deviation, and range for homogenous data and median and inter-quartile range for heterogeneous data. Qualitative data were presented as frequencies and proportions. Kolmogorov-Smirnov and Levene tests were used to determine the distribution characteristics of variables and variance homogeneity. Pearson's chi-square ($\chi 2$) test was used to analyze qualitative data. Mann-Whitney U test was used to analyze continuous data. A P-value of < 0.05 was accepted as statistically significant.

RESULTS

Lesions originated from retroperitoneal organs represent 52.4% of all studied lesions, while 47.6% were primary retroperitoneal masses, as shown in Table (1). The malignant lesions were about 61.9 % of all studied lesions, while 21.4% were benign and 16.7% were non-neoplastic. The foremost common malignant lesion was lymphoma and liposarcoma because each one constituted 19.2% of malignant lesions. The most common benign lesions were adrenal myelolipoma and AML as each one constituted 22.2% of benign lesions. The most common non-neoplastic lesion was pancreatic pseudo-cyst as it constituted 28.5% of non-neoplastic lesions, as shown in Table (2).

The pathological diagnosis was in step with CT imaging in69.0% of cases. The pathological correlation was done, either by fine needle biopsy

(3 cases), true-cut biopsy (17 cases), or surgical excisional biopsy (22 cases). There was no statistically significant difference between benign and malignant cases within the matching of the CT imaging diagnosis with the pathological diagnosis, *as shown in Table (3).*

CT imaging was 88.1% accurate in the diagnosis of total lesions, 100% accurate in the diagnosis of non-malignant lesions, and 80.8% accurate in the diagnosis of malignant lesions, *as shown in Table (4).*

Table 1: Origin of the studied lesions:

Origin of the retroperitoneal mass	Studied lesions (n=42)	
	No.	**%**
Primary retroperitoneum	20	47.6
Arising from retroperitoneal organs	22	52.4

Table 2: Pathological diagnosis of the studied patients:

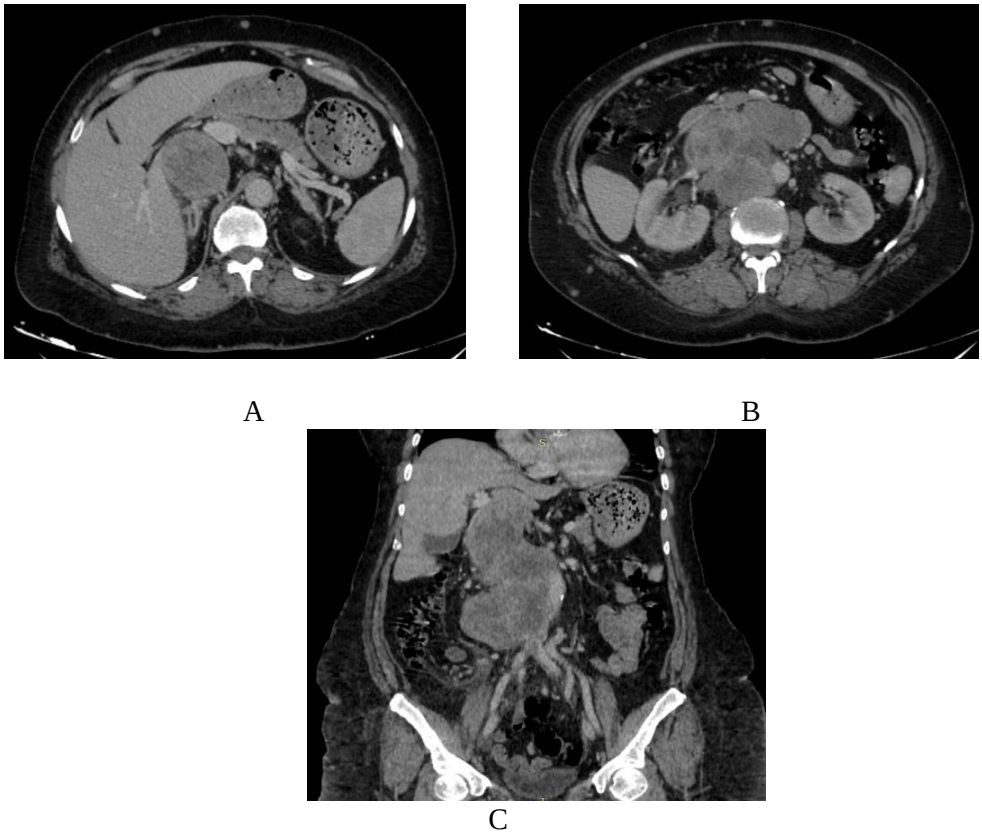
Pathological diagnosis	Studied patients (n=42)	
	No.	**%**
Non-neoplastic lesions (n=7):	**7**	**16.7**
Pancreatic pseudo-cyst	2	28.5
Retroperitoneal fibrosis	1	14.3
Pelvic lipomatosis	1	14.3
Lymphocele	1	14.3
Renal hematoma	1	14.3
Renal abscess	1	14.3
Benign lesions (n=9):	**9**	**21.4**
Adrenal myelolipoma	2	22.2
Angiomyolipoma	2	22.2
Multi-locular cystic nephroma	1	11.1
Adrenal hemorrhage	1	11.1
Fibromatosis	1	11.1
Retroperitoneal lipoma	1	11.1
Pancreatic mucinous cystic tumor	1	11.1
Malignant lesions (n=26):	**26**	**61.9**
Lymphoma	5	19.2
Liposarcoma	5	19.2
Pancreatic ductal adenocarcinoma	4	15.4
Neuroblastoma	3	11.5
Renal cell carcinoma	2	7.7
Rhabdomyosarcoma	2	7.7
Leiomyosarcoma	1	3.8
Synovial cell sarcoma	1	3.8
Adrenal metastasis	1	3.8
Ganglioneuroma	1	3.8
Renal pelvis Transitional Cell Carcinoma	1	3.8

Table 3: Matching of the CT imaging diagnosis with the pathological diagnosis:

Pathological diagnosis	Total (n=42)		Malignant (n=26)		Non-malignant(n=16	
	No	**%**	**No**	**%**	**No**	**%**
Consistent with CT diagnosis	29	69.0	18	69.3	11	68.7
One of 2 differential diagnosis by CT	8	19.0	3	11.5	5	31.3
One of more than 2 differential diagnosis by CT	2	4.8	2	7.7	0	0.0
Not included as DD by CT or no definite diagnosis by CT	3	7.2	3	11.5	0	0.0

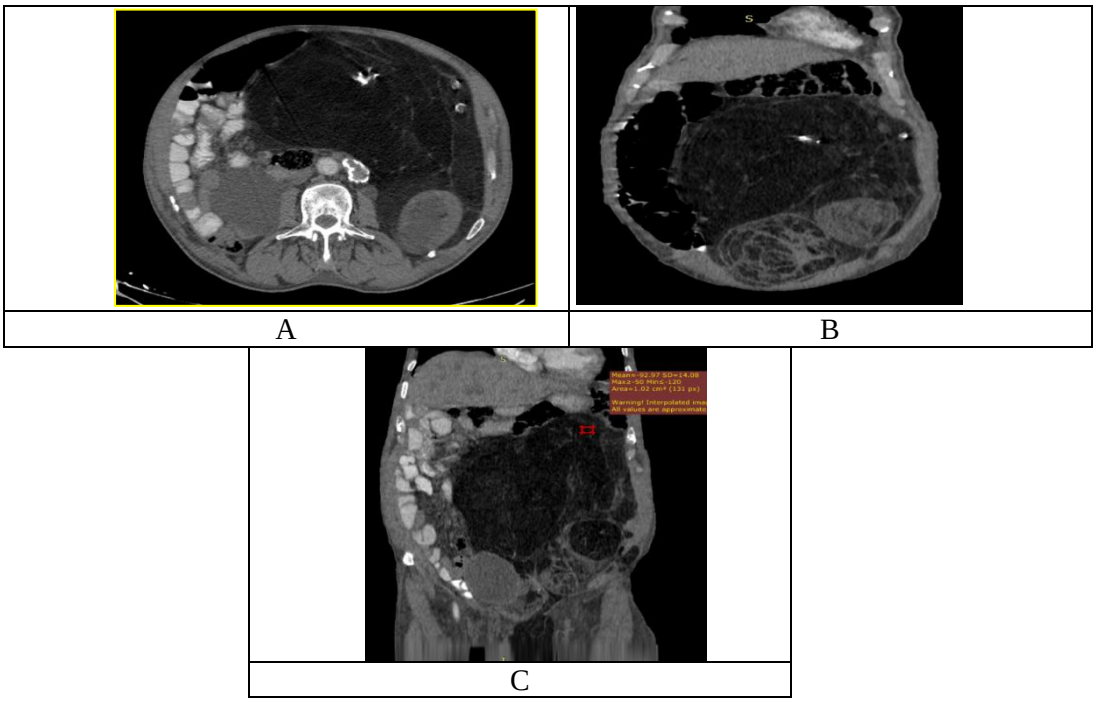
Table 4: Diagnostic accuracy of CT imaging in the studied lesions:

Diagnostic accuracy of CT	Total lesions	Malignant lesions	Non-malignant lesions
	88.1%	80.8%	100%



A B C

Fig.1: IVC leiomyosarcoma in a 61-year-old female patient complaining of abdominal pain, contrast-enhanced CT at the venous phase axial (A, B) & coronal (C) images showa large well defined lobulated outline retroperitoneal solid mass lesion, measuring about 210x130 mm. The mass is seen invading &extending along the rightward aspect of the IVC (involving its middle & inferior segments from D10 below hepatic veins to L5 confluence of both common iliac veins) sparing its superior segment from the hepatic veins to the Rt. atrium of the heart, having both intra & extra-luminal components. The mass is seen displacing the pancreas anteriorly, with lost in-between fat planes with the aorta, caudate lobe of the liver & the Rt. Psoas muscle.The mass showing extensive areas of necrosis inside. The mass is of moderate vascularity, with heterogeneous enhancement.

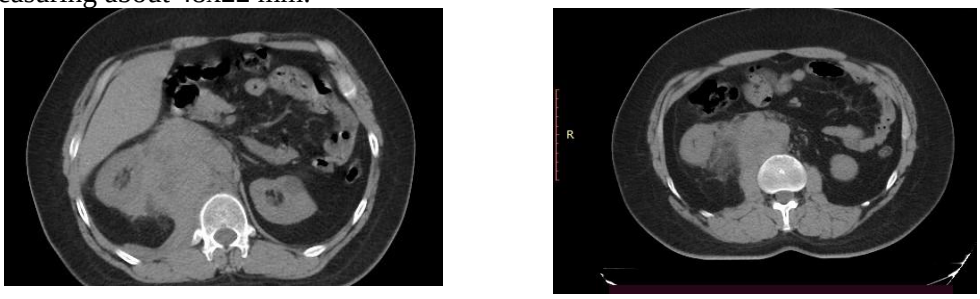


A B C

Fig.2: De-differentiated liposarcoma in an 81-year-old male patient complaining of abdominal enlargement & pain, contrast-enhanced CT axial (A), & coronal (B, C) reformatted images of the abdomen and pelvis show:A huge well defined retroperitoneal pelvi-abdominal solid mass lesion measuring about 188x240x381 mm, the

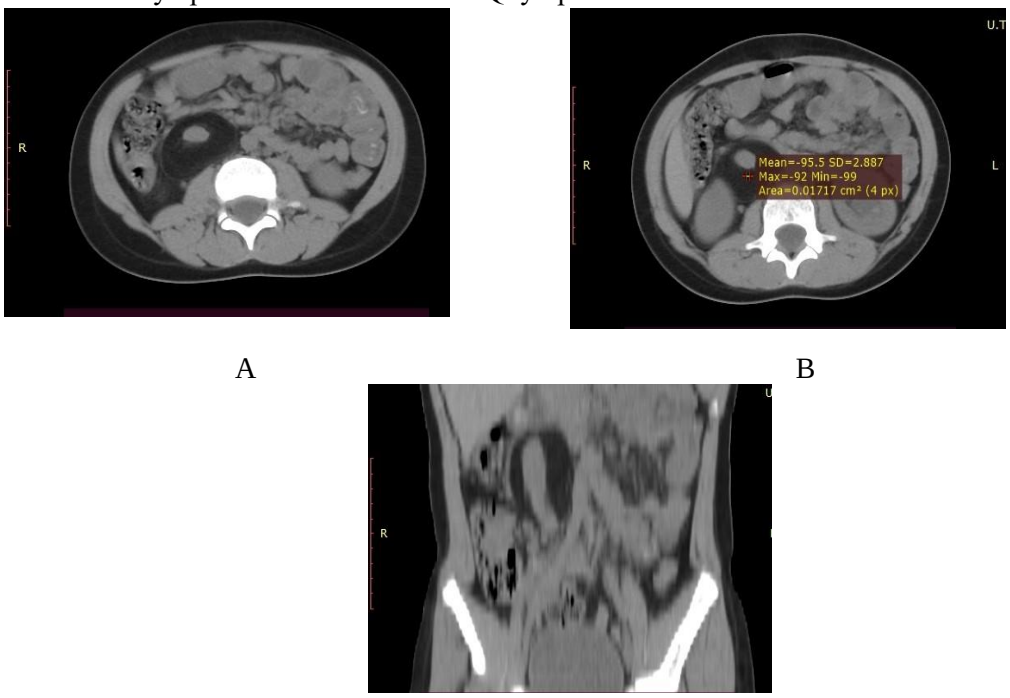
mass is occupying the whole middle and left aspects of the abdominal & pelvic cavities, encircling the Lt. kidney (but, not invading it) and extending down into the left inguinoscrotal hernia , the mass is seen displacing the UB & all the related bowel loops to the Rt. Side, exerting proximal colonic dilatation and compressing both ureters,exerting bilateral moderate renal hydronephrosis.

The mass is predominantly fatty attenuation with CT attenuation (-93 HU), thickenhancing septae, foci of calcifications, and multiple soft tissue components are noted, the largest one measuring 124x80 mm , with no necrosis.The lesion is hypo-vascular, showing faint septal enhancement.Large Lt. para-aortic calcified lymph node measuring about 48x22 mm.



A B

Fig 3: Retroperitoneal lymphoma, axial CT cuts of the abdomen reveals ill-defined soft tissue density mass seen at RT peri-spinal retroperitoneal space which cannot be separated from RT paravertebral muscle, the mass displacing the RT kidney upwards and outwards…..Q lymphomatous infilterate



A B

C

Fig 4: Intravascular lipoma axial CT cuts (A&B) and coronal CT cuts (C) reveals abnormal well defined hypodense lesion surround inferior vena cava by measuring the house unit density reveals -95 fatty density

DISCUSSION

Early management and treatment planning of the patients with various retroperitoneal masses need early detection and accurate diagnosis. Benign and malignant masses should be distinguished whenever possible to avoid unnecessary surgical procedures. The bulk of retroperitoneal masses are malignant with non-specific clinical presentations because the symptoms appear quite late within the clinical course. These tumors are often rather large at the time of diagnosis [6].

MDCT is the preferred method for the diagnosis of retroperitoneal tumors, because of its availability, reduced cost, high resolution, and short time required for the scan. A contrast-enhanced MDCT scan can detect the precise tumor location, nature, and components of the mass, the extension to the adjacent organs and relation to the blood vessels. It may also detect if there is a lymph node involvement or distant metastasis in cases of malignant tumors and thus staging of the malignant disease [7].

This study included 42 patients who had retroperitoneal masses, their age ranged from 4 months to 81 years old. In our study, we found that the retroperitoneal masses arised from

retroperitoneal organs were more common and more frequent than the primary retroperitoneal masses. This was in agreement with Scali et al. [2] who reported that the majority of retroperitoneal masses arises from retroperitoneal organs and are therefore not considered primary retroperitoneal mass.

In our study, the bulk of the retroperitoneal masses were malignant constituted 61.9% of all cases (n=26), followed by the benign lesions constituted 21.4% (n=9), then the non-neoplastic lesion constituted 16.7% (n=7). These results were in agreement with Jo &Fletcher [8] who reported that malignant tumors of the retroperitoneum are roughly four folds more frequent than benign lesions, in contrast to neoplastic disease occurring elsewhere in the body, where benign disease predominates and Khalifa [9] who found that the malignant masses represented 70% of the whole retroperitoneal masses with malignant to benign masses ratio 2.3:1 as well as Neville et al. [10] who stated that seventy-eighty percent of all primary retroperitoneal tumors are malignant and these tumors cover 0.1–0.2% of all malignancies.

In our study, the foremost common malignant retroperitoneal masses were lymphoma and liposarcoma, each one constituted 19.2% (n=5 cases) of malignant lesions. This was in agreement with Kamel [11] who found that lymphomas were the foremost frequent type 3 cases from 32 cases (9.4%) and retroperitoneal liposarcoma was the second foremost common type 3 cases (9.4%) and Shalaan [12] who found that lymphoma was the most common retroperitoneal mass 7 cases from 50 cases (14%) as well as Neville et al. [10] who stated that lymphoma is the most common retroperitoneal cancer and Craig et al. [13] who stated that 33% is that the incidence of retroperitoneal fat-containing masses such as liposarcoma.

In our study, the foremost common benign retroperitoneal mass was renal angiomyolipoma& adrenal myelolipoma, each one constituted 22.2% (n=2) of benign lesions. This was in agreement with Pedrosa et al. [14] who reported that angiomyolipomas are the foremost common benign solid renal lesion and also the foremost fat-containing lesion of the kidneys andKamel [11] who found that renal angiomyolipoma was the foremost common benign retroperitoneal mass in his study constituted 6.2% (n=2/30).

In our study, the foremost common non-neoplastic mass was pancreatic pseudo-cyst, it constituted 28.5% (n=2) of non-neoplastic lesions; this was in disagreement with Shaalan [12] who found lymphocele was the most common non-neoplastic retroperitoneal mass comprising 6% (n=3/50) of the total retroperitoneal masses. This could be attributed to the increased frequency of pancreatitis and therefore the occurrence of its complications.

In our study, the CT imaging diagnosis of retroperitoneal masses was compared to the pathological diagnosis to assess the accuracy of the CT in diagnosis of various retroperitoneal masses. We considered positive results when the pathological diagnosis was matched with the only diagnosis by CT 69% of total cases (n=29 cases) or was one of amongst quite two differential diagnoses by CT 19% of the total cases (n=8 cases), and negative results: when the pathological diagnosis was one amongst two differential diagnoses by CT 4.8% of overall cases (n=2 rhabdomyosarcoma and ganglioneuroma) or was not included as differential diagnosis by CT " no definite diagnosis was reached by CT " 7.2% of total cases (n=3 myxoidliposarcoma, synovial cell sarcoma & rhabdomyosarcoma). This may be attributed to the non-specific imaging features of both rhabdomyosarcoma and synovial cell sarcoma, and the high similarity of the myxoid liposarcoma to the retroperitoneal hematoma which is more expected to occur ,and the atypical appearance of the only included case of ganglioneuroma with its unusual large size, intra-spinal extension & multiple retroperitoneal lymph gland involvement.

Positive results were obtained in 37 lesions out of total 42 cases, and negative results were obtained in just 5 lesions out of total 42 cases, with CT accuracy about 88.1% in diagnosis of the full included retroperitoneal lesions (CT was 80.8% accurate in diagnosis of malignant lesions and100% accurate in diagnosis of non-malignant lesions). This was in agreement with Shalaan [12] who reached to similar results to our study ,with reported 74% CT accuracy assisted by postulated scheme in diagnosis of 50 included cases of retroperitonel lesions (positive results in 37 cases ,and negative results in 13 cases) . in addition, it was in agreement with a study done by Küster et al [15] where CT examinations were done for 287 patients and concluded that CT should be used in the first place in the course of diagnostic staging procedures of patients with retroperitoneal tumors and tumor recurrence, this was justified by an overall diagnostic accuracy of 90%, and Neifeld et al. [16] who studied 21 patients with retroperitoneal sarcomas, CT was misleading in only three patients and accurate in 18 patients. It was also useful in detecting recurrence by follow-up scanning and determining response to chemotherapy.

In conclusion, our results indicate that that MDCT has high accuracy in diagnosis and detection of the

different retroperitoneal masses reaching up to 88.8%. MDCT is the most accurate radiological modality for early diagnosis, characterization and differentiation of retroperitoneal masses, and early and proper management

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How to cite

Anwar, D., M. Abdelhay, R. The Role of Multidetector Computed Tomography in Characterization and Differentiation of Retroperitoneal Masses.. Zagazig University Medical Journal, 2023; (525-531):-.doi: 10.21608/zumj.2021.77165.2241