International Journal of Radiology and Diagnostic Imaging

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A comparative evaluation of ultrasonography versus computed tomography in the assessment of retroperitoneal masses

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DOI: http://dx.doi.org/10.33545/26644436.2021.v4.i4a.241

Abstract
Background: Classification of retroperitoneal masses due to its specific masses aid in their accurate diagnosis and management. Evaluation of retroperitoneal masses are challenging due to overlapping imaging findings. Among the several imaging modalities, researchers have considered ultrasonography (USG) and multidetector computed tomography (MDCT) as the imaging modalities of choice. The use of USG over MDCT was preferred in a rural population due to high cost and ionizing radiations of MDCT.
Aim and Objective: To evaluate the utility of USG and MDCT to identify and categorize retroperitoneal masses and to correlate the USG findings with that of MDCT.
Materials and Method: Seventy-two patients with signs and symptoms of retroperitoneal masses were evaluated by both USG and MDCT. Ultrasound characteristics like size, appearance, echotexture, vascularity and other findings were studied. The findings were then compared with the findings of MDCT. Subjects were evaluated for study variables from USG and CT which were presented as percentages. Based on percentages, the accuracy was calculated.
Results: Of the 72 patients included in the study, USG had accuracy of 76.4% in the identification and characterization of the retroperitoneal masses as compared to that of MDCT.
Conclusion: Ultrasound can be considered as the primary tool for evaluating retroperitoneal lesions and MDCT for confirmation and for evaluating the complete extent of the lesions.

Keywords: multidetector computed tomography, peritoneal diseases, retroperitoneal space, ultrasonography

Introduction

Retroperitoneal masses can emerge from heterogeneous tissues. The retroperitoneum, located in the abdomen comprises of various solid organs and can [1] present with a broad set of symptoms which may lead to ambiguity in the diagnosis [1]. Primary retroperitoneal tumors are reported to account for 0.16% of all malignancies, and 10–20% of all primary retroperitoneal tumors are liposarcomas [4].

Description of the location of lesion, characteristic features of the various retroperitoneal masses may aid in the differential diagnosis [5]. Ultrasonography (USG), Computed tomography (MDCT) and Magnetic resonance imaging (MRI) are the prevalent imaging modalities available to evaluate masses in the abdomen [6]. MDCT was considered as the imaging modality of choice for characterization of retroperitoneal masses [7]. It is used in cases with insufficient USG findings or for the diagnosis of lesions which could not be imaged by USG due to the overlying bowel gas and body habitus [8]. When compared to other modalities MDCT showed better performance to evaluate the vascular movement which is further helpful in predicting the tumor respectability [9]. Hence MDCT has been used widely as an important pre-operative examination in patients due to its spatial and temporal solution and a wide anatomic coverage [8]. However, due to its high cost and ionizing radiations, the use of MDCT is challenging and at this juncture, USG proved to be helpful. USG is the commonly used modality due to non-invasiveness and cost-effectiveness. It is often considered as the preferred imaging modality of choice for an abdominal mass. Hence it was considered as an ideal investigative tool for the lower socioeconomic group [8]. MRI is used to diagnose lesions which are not diagnosed by USG and MDCT. Current study concentrated on USG and MDCT due to the unavailability of modern imaging techniques like MRI in a rural setting.

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Limited studies have been conducted on the evaluation of retroperitoneal masses with the usage of USG and MDCT in this regional area. Extensive review of literature does not provide adequate information on the prevalence of retroperitoneal masses in India. Hence, this study was carried out to establish the baseline to compare the usage of USG and MDCT considering MDCT as a base for the diagnosis of retroperitoneal masses in a rural population. This study was conducted to determine the location of masses, morphological characteristics and the organ of origin in the retroperitoneal spaces. The study also probed the efficacy of grey scale ultrasound and color Doppler in benign or malignant lesions. Through this, the study aimed to correlate the USG findings with that of MDCT.

Materials and methods

This descriptive study was conducted in a tertiary care hospital from January 2018 to September 2019. The Institutional Medical Ethics Committee Clearance and informed consent was obtained from subjects participating in the study. Subjects with signs and symptoms of retroperitoneal masses (from kidneys, ureters, adrenals, duodenum, pancreas, abdominal aorta, ceacum, anterior and posterior pararenal space, perirenal space and retroperitoneal lymph nodes) both solid and cystic referred to the Department of Radiology were included. Among the 72 subjects included, 48 were male and 24 were female subjects. Patients who were contraindicated to iodinated contrast and ionising radiation, with known benign findings like renal calculi and simple renal cysts were excluded from the study. All the eligible subjects were recruited into the study by convenient sampling method. All the study subjects underwent sonographic examination followed by tomographic examination.

Primary screening was conducted by USG using GE S7, Mind ray DC-8 and Seimens Acuson S2000 ultrasound machines in longitudinal and transverse directions covering all the areas of interest. Both low frequency curvilinear (4 – 6Hz) and high frequency linear (7 – 12 Hz) probes were used. Patients were also scanned in prone and lateral positions. On gray scale sonography following things of masses were evaluated: location, organ of origin, characteristics of mass like size, appearance and echotexture. This was followed by colour Doppler examination to know the vascularity of the masses. Other findings like metastasis, lymph nodal involvement and infiltration to surrounding structures were also studied. As a confirmatory method, CT scan was done using 128 slice GE optima 665 CT machine. Both contrast as well as non-contrast study was done. Images were taken with a collimation of 1- to 3- mm to allow coverage of the area of interest in single breath-hold. The characteristics like size, appearance, echotexture, metastasis, lymph nodal involvement and infiltration to surrounding structures were studied. In addition, the enhancement pattern of the masses was also studied with contrast enhanced CT.

Subjects were evaluated for the study variables from USG and CT findings which included age, sex, organ of origin, size, appearance, echotexture and vascularity. All the study variables were presented as percentages. Based on percentages, the accuracy was calculated.

Results

The mean age of patient population was 50.4 years. The demographic details were categorized as follows: among the 72 patients, 48 were male and 24 were female patients. Patients were grouped broadly into five categories based on their age groups (Table 1).

Table 1: Demographic Characteristics

Variables	Number (%)
Age group (years)	
15-30	4 (5.56)
30-45	7 (9.72)
45-60	28 (38.89)
60-75	31 (4)
NA	2 (2.78)
Gender	
Male	48 (66.67)
Female	24 (33.33)

Among the 72 cases, 30% of patients complained of pain in abdomen and vomiting, followed by loss of appetite (19%) and weight loss (15%). Incidental symptoms were observed in 15% of patients. Few patients complained of a lump in abdomen (7%), fullness in abdomen (7%) and trauma (6%) (Table 2).

Table 2: Distribution of cases according to symptoms

Symptoms	Cases	Percentage
Pain abdomen and vomiting	22	30
Lump in the abdomen	05	7
Loss of appetite	14	19
Fullness in abdomen	05	7
Weight loss	11	15
Trauma	04	6
Incidental	11	15

Distribution of the cases according to organ of origin for USG and CT are depicted in Table 3. Majority of the cases had kidney as the organ of origin with 24 subjects by USG and 28 subjects by CT findings.

Table 3: Distribution of cases according to organ of origin for USG and CT

Organ of origin	Type of investigation	Number of cases (%)
Kidney	USG	24 (33.33)
	CT	28 (38.89)
Pancreas	USG	7 (9.72)
	CT	9 (12.50)
Adrenals	USG	13 (18.06)
	CT	18 (28)
Cecum	USG	1 (1.39)
	CT	1 (1.39)
Psoas	USG	3 (4.17)
	CT	5 (6.94)
Aorta	USG	5 (6.94)
	CT	7 (9.7)
Primary retroperitoneal masses	USG	2 (2.78)
	CT	3 (4.1)

CT: computed tomography, USG: ultrasonography

A comprehensive analysis of the various characteristics was done. The size of the masses on USG and CT were broadly grouped into 4 categories based on the size of the masses. Majority of the cases had a size ranging from 2-5 cm detected on USG and CT. Appearance of masses were categorized into three as solid, cystic and solid/cystic. With

respect to the size, only 11 masses with <2 cm was identified by USG as compared to 17 masses by CT. Based on the echotexture, the masses were categorized into three. Maximum percentage of masses were hypoechoic, and a minimum percentage of masses were hyperechoic by both USG and CT. CT identified calcifications in 7 cases compared to 6 cases by USG (Table 4).

Table 4: Comparison of the Characterization of masses by USG and CT

Category	Type of investigation	Frequency
Size of the masses		
<2cm	USG	11 (20)
	CT	17 (23.61)
>8cm	USG	9 (16.36)
	CT	9 (12.5)
2-5cm	USG	26 (47.27)
	CT	35 (48.61)
5-8cm	USG	9 (16.36)
	CT	11 (15.28)
Appearance of the masses		
Solid	USG	38 (69.09)
	CT	53 (73.61)
Cystic	USG	14 (25.45)
	CT	15 (20.83)
Solid/cystic	USG	3 (5.4)
	CT	4 (5.56)
Echotexture		
Hypoechoic	USG	35 (63.63)
	CT	45 (62.5)
Hyperechoic	USG	5 (9.09)
	CT	7 (9.72)
Heterogenous	USG	15 (27.27)
	CT	20 (27.78)
Calcification		
Present	USG	06 (10.71)
	CT	07 (8.3)
Absent	USG	49 (87.5)
	CT	65 (90.27)

CT: computed tomography, USG: ultrasonography

The vascular pattern of the masses on color doppler showed 25.45% of the cases as mildly vascular and moderate vascular, whereas no vascularity was recorded in 49.09% cases. With regards to the enhancement pattern on CT, the masses were grouped based on three categories as homogenous, heterogenous and non-enhancing. Majority of the masses showed enhancement on intravenous contrast administration and reported 55.56% non-enhancing. The masses showed enhancement in the arterial phase or in the venous phase after administration of contrast intravenously.

With respect to the tumor analysis, ultrasound demonstrated the infiltration into surrounding structures in only 14% cases whereas CT found infiltration in 44% of cases. Metastasis was noted in 7% of cases on USG as compared to 27% of cases on CT. Lymph nodal involvement was found in 22% on USG compared to 42% on CT.

Comparison of the diagnosis of retroperitoneal masses by USG and CT are presented in Table 5. USG demonstrated multiple rounded to oval well-defined anechoic lesions with posterior enhancement in all the 9 cases. Internal debris, septations and calcifications were clearly demonstrated in by ultrasonography. Thus, the findings of the ultrasound were comparable with CT.

Among the 6 cases with pancreatic fluid collections, 5 cases were detected by USG as compared to all 6 cases in CT. One case with delineation was missed on USG as it was obscured by bowel gas. With respect to the pancreatic carcinoma, 1 case where the mass was <2cm by USG showed only indirect signs like common bile duct (CBD) and main pancreatic duct dilatation with intrahepatic biliary radicle dilatation (IHBRD). Among the 2 cases of ceacal masses identified, USG identified ceaecal thickening with lymphadenopathy in one case and in another case, retroperitoneal fat stranding was observed. With respect to psoas abscess, USG demonstrated elongated hypoechoic cystic area in the substance of psoas muscle with internal echogenic debris in 3 out of 5 cases. Ultrasound demonstrated aortic aneurysm as an incidental finding in 5 cases out of 7 cases identified on CT. With regards to adrenal lesions, USG had missed 5 lesions which were demonstrated on CT. Two cases of adenoma and 3 cases of myelolipomas were missed on USG which were <2cm in size. USG was able to diagnose only one out of 2 cases of retroperitoneal abscess due to large size of lesion. Overall, it was observed that USG was less sensitive for the detection and characterization of retroperitoneal masses which were smaller than 2 cm, as compared to CT (Table 5) (Figure 1).

Table 5: Comparison of diagnosis of retroperitoneal masses by USG and MDCT

Diagnosis	No. of cases	No. of cases by USG (%)	No. of cases by MDCT (%)
RCC	04	04 (100)	04 (100)
Renal Hematoma	04	02 (50)	04 (100)
Renal abscess	11	09 (81.81)	11 (100)
Complex renal cysts	09	09 (100)	09 (100)
Pancreatic fluid collections	06	05 (83)	06 (100)
Pancreatic carcinoma	03	02 (66.67)	03 (100)
Adrenal adenoma	08	06 (75)	08 (100)
Adrenal myelolipoma	08	05 (63)	08 (100)
Pheochromocytoma	02	02 (100)	02 (100)
Ceacal carcinoma	02	01 (50)	02 (100)
Psoas abscess	05	03 (60)	05 (100)
Aortic aneurysm	07	05 (71)	07 (100)
Retroperitoneal liposarcoma	01	01 (100)	01 (100)
Retroperitoneal abscess	02	01 (50)	02 (100)

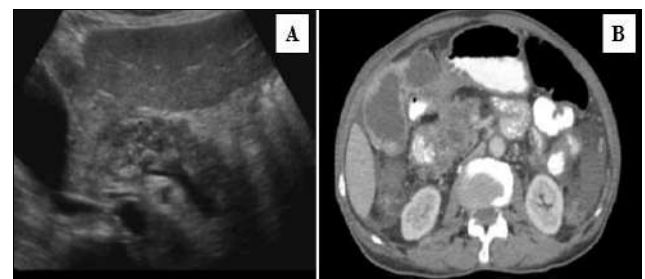MDCT: multidetector computed tomography, RCC: renal cell carcinoma, USG: ultrasonography

Fig 1: Pancreatic carcinoma **A:** USG of pancreatic carcinoma; **B:** Contrast enhanced MDCT of pancreatic carcinoma
USG: ultrasonography, MDCT: multidetector computed tomography

In the current study, the accuracy of USG in determining the lesions was 76.4% as compared to CT.

Discussion
Primary retroperitoneal masses could be diagnosed after the location was confirmed within the retroperitoneal space and

after an organ of origin was excluded [10]. Diagnosis presents a challenge for the radiologists though different imaging techniques proves efficient in the demonstration of important characteristics of the tumors. Radiologic findings in the combination with the clinical data of patients could help in the correct diagnosis in many cases [8].

In our study, among the 72 patients, USG accurately identified the masses in 55 cases and CT was able to identify and characterize masses in all the 72 cases. Out of the 11 cases of renal abscesses, characterization was done for 9 cases by USG. Helenon *et al.* studied the USG characteristics of patients with renal tumors and concluded that the routine abdominal ultrasound had a significant role in the early diagnosis of renal tumors [11]. A similar study was conducted by Ali *et al.* with respect to the significant role in the follow up for the percutaneous drainage of abscess and proved that the USG played a significant role [12]. A study conducted by Tsili *et al.* stated that MDCT also proved accuracy of 91% in the diagnosis of renal cell carcinoma (RCC) in staging of the tumor [13]. It also showed its efficacy in the assessment and diagnosis of renal infection site and the extent of the abscess [12]. Morosi *et al.* conducted a study on the comparison of fatty and non-fatty retroperitoneal tumors. Detection on CT revealed a sensitivity and specificity of 76.7% and 92% for liposarcoma compared to sensitivity and specificity of 55.4% and 0% for mesenchymal tumor [14]. As the base for sensitivity and specificity has been already proven with the above results as per Morosi *et al.*, our study concentrated on other parameters for the diagnostic efficiency of USG compared to CT [14].

Among the 6 cases identified with pancreatic fluid collections, USG detected 5 cases, whereas MDCT was able to detect all the cases with pancreatic fluid collection. However, delineation of a small wall of necrosis was missed on USG as it was obscured by bowel gas. Similar to this study, a study conducted by Takahashi reported that all the 73 patients with pancreatic fluid collections were detected by CT with an accuracy of 79.5% to 83.6% [15].

Among 3 patients with pancreatic carcinoma, USG was able to detect only 2 cases as compared to CT as in one case detected by USG, the mass was <2cm which showed only indirect signs like CBD and main pancreatic duct dilatation with IHBRD. Ultrasound helps to evaluate the organ size, borders, echo-structure, vessels and ducts of pancreas which further helps to diagnose many diseases associated with pancreas [16]. Lee *et al.* studied the characteristics of pancreatic carcinoma in various sectional imaging modalities and concluded that USG is the initial investigation of choice in patients presenting with abdominal pain or jaundice and MDCT compared to other cross-sectional imaging showed better performance in the evaluation of vascular involvement in predicting tumor respectability as similar to our study [17].

Ultrasound was considered as an efficient diagnostic tool for guidance of drainage or aspiration. The accuracy and sensitivity of USG allows to detect enlarged retroperitoneal lymph nodes. It remains as a mainstay of radiological investigation for patients with symptoms related to abdominal pathology. Hence USG proves to be useful for diagnostic biopsy and follow up during surgical management of lesions [8]. USG demonstrated elongated hypoechoic cystic area in the substance of the psoas muscles with internal echogenic debris in 60% of cases. USG guided

drainage of the abscess was done in all the cases. Thus, ultrasound was helpful diagnostically as well as therapeutically. Mallick *et al.* in a similar study on imaging features of psoas abscess concluded that USG could diagnose psoas abscess in only 60% of cases [18]. Similarly, USG demonstrated aortic aneurysm as an incidental finding in 71% of cases. A study conducted by Kumar *et al.* mentioned that various studies have proved that abdominal aortic aneurysm screening using USG was effective and decreases adverse health outcomes related to the condition [19].

With respect to primary retroperitoneal lesions, USG was able to diagnose only one out of two retroperitoneal abscesses as complete evaluation of the retroperitoneal mass, its extent and echotexture were not possible due to the large size of the lesion. In adrenal lesions, USG diagnosed only 2 cases of retroperitoneal lesions and missed 5 lesions due to large size. In contrast, Chaudhari *et al.* concluded that radiological investigation mainly MDCT is the imaging modality of choice for the diagnosis of primary retroperitoneal masses [20].

Our study reported that, the accuracy of determination of lesion in USG was 76.4% compared with MDCT. It was observed that USG was less sensitive for the detection and characterization of retroperitoneal masses which are smaller than 2 cm as compared to CT. In a study done by Pant *et al.* USG correctly detected 46 out of the total 50 cases having an accuracy of 92% for the detection and evaluation of retroperitoneal lesions which was more than the current study [3]. Another study carried out by Harinath *et al.* in 30 patients comparing both USG and CT in the evaluation of abdominal masses concluded that the CT was more sensitive than USG in demonstrating the morphological features of abdominal masses like echogenicity, vascularity, density, contrast enhancement characters, tumoral necrosis, calcifications, presence or absence of fat, regional lymphadenopathy, infiltration into the adjacent structures and distant metastase [8]. Advantage of USG over MDCT was that, USG is easily accessible and there is no exposure to ionizing radiations in USG as compared to MDCT [21].

However, USG is dependent on the proficiency of the operator, which could impact its diagnostic utility [3]. Nevertheless, it can be considered as a preliminary imaging tool in patients with symptoms related to retroperitoneal pathology. Patient acceptability was better not only due to the reasonable cost but also due to the non-invasiveness of the USG. Followed by USG, MDCT can be considered as a confirmatory tool for detection of retroperitoneal masses.

Conclusion
Ultrasonography is a preliminary screening modality in the investigation of patients with symptoms related to retroperitoneal pathology. This study proves that the USG is safe, quick, reliable, non-invasive and cost effective. Hence, USG can be recommended as a primary screening tool for evaluating retroperitoneal lesions and CT can be used as a confirmatory tool for the further evaluation of the complete extent of lesion. Therefore, more studies are required to be conducted on a larger population over a long duration to discover a method that combines the cost-effectiveness of USG and accuracy of CT with similar availability.

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