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Research Paper

Role of Ultrasound in the Assessment of Anterior Abdominal Wall Lesions

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ABSTRACT:

BACKGROUND:

The clinical manifestations of anterior abdominal wall diseases are diverse. Cross-sectional imaging frequently reveals abdominal wall lesions, which are typically unnoticed. It can be difficult to distinguish between various sorts of masses based only on imaging characteristics.

OBJECTIVE:

To assess the diagnostic accuracy of ultrasonography for anterior abdominal wall lesions.

PATIENTS AND METHODS:

From January 2022 to December 2022, researchers from Al-Yarmouk Teaching Hospital conducted a prospective study. A total of 102 individuals with anterior abdominal wall swellings were included in the research. All of the patients had undergone a targeted ultrasound examination. The findings were compared to the patients' surgical findings and histological findings.

RESULTS:

The most prevalent pathologies were hernia (31.38%), post-operative collections (25.48%), and endometriosis (14.71%). In compared to surgical and histological findings, ultrasonography demonstrated 99% sensitivity, 97.06% accuracy, and 98.02% positive predictive value (PPV) for the identification of different anterior abdominal wall lesions.

CONCLUSION:

Abdominal wall lesions are common clinical manifestation. Although there are multiple possible diagnoses, in most cases, an accurate diagnosis can be made or the scope of the differential diagnosis can be narrowed by combining clinical and imaging features. A few types of masses, however, still require pathological diagnosis.

KEYWORDS: ultrasound, abdominal wall, mass, mass like**.**

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INTRODUCTION:

Abdominal wall masses and lesions that resemble masses are common. It can be difficult to distinguish between various sorts of masses based only on imaging characteristics. Furthermore, such masses and mass-like processes can occur inadvertently during cross-sectional imaging.[(1)].

The mass is initially examined to ensure that it is not caused by a mass-like process, such as a hernia. The internal composition of the mass (for example, fat, fluid, solid, or fibrous component) should be determined next [(2)]. Desmoid tumors, metastases, endometriomas, and sarcomas all have augmentation, whereas lipomas are mostly fat-based. [(3)] Finally, specific patient histories, symptoms, or syndromic illnesses can help in the identification of abdominal wall tumors. [(4)]. The American College of Radiology's (ACR) Appropriateness Criteria for Palpable Abdominal Masses state that ultrasonography with color Doppler investigations is the best first-line modality for imaging palpable soft tissue masses in the abdominal wall [(5)]. The use of high-frequency linear transducers, which can be supplemented with a low-frequency (deep) probe for deeper tissues and thick abdominal walls, typically results in good clarity and resolution, as well as real-time dynamic palpation and mass manipulation [(6)]. The ultrasound is commonly utilized for image-guided percutaneous biopsy of abdominal wall masses, which allows for real-time imaging [(7)].

PATIENTS AND METHODS:

This is a prospective study which was conducted in Al-Yarmouk teaching hospital from January 2022 to December 2022. The study included a total of 102 patients suffering from anterior abdominal wall swellings and referred for their diagnostic evaluation to the radiology department. The study was approved by Iraqi Council for Medical Specializations.

- **Inclusion Criteria**
  - Patients presenting with anterior abdominal wall swelling.
- **Exclusion Criteria**
  - Cases with acute abdominal wall trauma
  - Patients did not do operation or histopathological studies

Data Collection

Detailed history was taken from all patients including their age, duration of symptoms and previous medical and surgical history.

All patients had targeted abdominal wall ultrasonography examinations utilizing the Voluson E6 ultrasound equipment and the HS40 Samsung Medison ultrasound machine.

All exams were performed using a linear probe (9-11 MHz for GE Voluson and 3-16 MHz for Samsung) and, in certain cases, a curvilinear probe (1-5 MHz for GE Voluson and 2-8 MHz for Samsung) for thick abdominal walls and deeper structures beyond the depth of the linear probe.

The examination was conducted under the supervision of an expert radiologist with over 10 years of experience doing different ultrasound tests, who monitored all examination processes for all patients in the study.

Examination protocol

The examination processes were thoroughly presented to the patients, and they had received enough training for dynamic maneuver execution.

The gel (matching medium) was placed on the ultrasonic probe and warmed if feasible.

An ultrasound examination was carried out at the patient's complaint location. A multiplanar scan was conducted. Power or color Doppler imaging was used to assess the vascularity of the lesions and their relationship to regionally relevant arteries.

Hernia defect widths and contents were measured and examined. If no hernia was discovered, straining activities like Valsalva or doing the test while the patient was standing were utilized as alternatives.

The size, position, and echogenicity pattern of any mass lesion were investigated in several orthogonal scanning planes, as well as the internal vascularity and relationship to any vital structure. Similar techniques were utilized to examine each cystic lesion, including manual compression with the probe to verify lesion compressibility and the presence of a deep connection to the abdominal cavity.

Statistical analysis

All statistical analyses were carried out using IBM SPSS 25.0 (IBM, Armonk, New York, USA). Quantitative variables were represented as mean ± SD and range. Discrete variables were expressed as numbers and percentages. The sensitivity, accuracy, and positive predictive value of US in the diagnosis of various anterior abdominal wall diseases were determined using Chi square, with histology, aspiration, or surgical findings serving as gold standards depending on the case.

RESULTS:

Demographic Characteristics of the Patients:

The present study included 102 patients suffering from anterior abdominal wall mass or mass-like lesion. The mean age of the patients was 42.18±12.71 years (18-70 years). Females were more frequently affected than males (67 out of 102). Comorbidity was also estimated including type II diabetes mellitus and hypertension, as shown in [table 1].

Table 1: Demographic characteristics of patients (n=102).

Variables	Value
Age, years	
Mean±SD	42.18±12.71
Range	18-70
Gender	
Male	35(34.31%)
Female	67(65.69%)
Comorbidity	
T2DM	18(17.65%)
Hypertension	20(19.61%)

Clinical and imaging Characteristics of the Patients

According to the primary clinical presentation [table 2], a total number of 36 patients were presented with hernia which was the most common pathology accounting for 35.28 %. Half of these hernias were inguinal, followed by ventral (10.78%), then incisional hernia (6.86%). The second most common presentation was post-operative anterior abdominal wall fluctuant swellings (n =25, 24.51%) after variable duration mainly within the first three weeks.

There were 24 patients (23.53%) who came with an abdominal wall mass, which was initially a non-specific clinical diagnostic but later shown to be various lesions on high-resolution sonography and in histology.

Soft mobile nodules presented more commonly in obese patients and diagnosed clinically as lipoma with a total number of 9 cases (8.83%). There were 8 female patients (7.85%) presented with painful nodules at site of surgical scar and referred to role-out scar endometriosis.

Table 2: Different clinical diagnoses for anterior abdominal wall lesions.

Clinically defined	No.	%
Inguinal hernia	18	17.64
Incisional hernia	7	6.86
Ventral hernia	11	10.78
Post-operative collection	25	24.51
Non-specific abdominal wall mass	24	23.53
Lipoma	9	8.83
Endometriosis	8	7.85
Total	102	100%

Correlation of ultrasound findings with histopathology and operative findings

All patients were examined with ultrasound and divided into two groups to be correlated with operative findings and histopathological results as shown in [table 3].

First group had sonographic features of mass like lesions (32 patients with variable types of hernias, 2 patients with undescended testes, 2 patients with hydrocele of the canal of Nuck). All these sonographic findings were correlated with surgical results as a gold standard.

Second group had sonographic features of different abdominal wall masses which were compared with the final results of histopathological study as a gold standard.

The results of ultrasound examination included 11 cases of lipomas, 2 cases of epidermal inclusion cysts, 4 cases of desmoid tumors, 15 cases of scar endometriosis, 3 cases of hematomas, 11 cases of abscesses, 11 cases of seromas, 4 cases of suture granulomas, 4 cases of metastases and 1 case of post-surgical scar fibrosis according to the echogenicity and consistency of the lesion with the use of color Doppler study and depending on the clinical data with medical and surgical history of the patients.

In comparison with histopathological results [table 4], one case out of 15 cases of endometriosis was proved to be a suture granuloma , in addition to the case of post-surgical scar fibrosis was proved to be a scar endometriosis in histopathological study. Also one case out of 4 cases of desmoid tumors was proved histopathologically to be a rectus sheath hematoma.

Table 3: Overall ultrasound, surgical, and histological correlation.

cases=102	Ultrasound findings	Surgical findings	histological findings
14	Inguinal hernia	Bowel loops and Mesentery noted	
7	Incisional hernia	Defect in fascia transversalis' external oblique muscle	
11	Ventral hernia	Linea alba defect	
2	Undescended testis	Poorly developed testis noted within the inguinal canal.	
2	Hydrocele canal of Nuck	Cystic lesion noted, surgical resection done with ligation of the neck of the processus vaginalis	
11	Lipoma		Mature adipocytes with no cellular atypia
2	Epidermal inclusion cyst		The cystic cavity is filled with keratin debris and is surrounded by a wall of stratified squamous epithelium.
4	Desmoid tumor		Sweeping fascicles with spindle cells, long thin-walled parallel capillaries with neighboring infiltration.
15	Scar Endometriosis		endometrial glands and stroma with hemorrhage
3	Hematoma		On aspiration blood material noted
11	Abscess		Pus drained
11	Seroma		Clear serous fluid drained
4	Suture granuloma		Multinucleated large cells with randomly distributed nuclei. The foreign body was found at the center of the granuloma or inside the large cells.
4	Metastasis		Accordingly (The same histopathology of the primary malignancy)
1	Post-surgical scar fibrosis		show endometriosis (Endometrial glands and stroma)

Table 4: Final diagnosis of anterior abdominal wall lesions according to the histopathology and operative findings.

Final Diagnosis	Gold standard	No.	%
Inguinal hernia	Operation	14	13.74
Incisional hernia	Operation	7	6.86
Ventral hernia	Operation	11	10.78
Undescended testis	Operation	2	1.96
Hydrocele of the canal of Nuck	Operation	2	1.96
Lipoma	Histopathology	11	10.78
Epidermal inclusion cyst	Histopathology	2	1.96
Desmoid tumor	Histopathology	3	2.94
Scar endometriosis	Histopathology	15	14.71
Hematoma	Aspiration with cytology	4	3.92
Abscess	Aspiration with cytology	11	10.78
Seroma	Aspiration with cytology	11	10.78
Suture granuloma	Histopathology	5	4.91
Metastasis	Histopathology	4	3.92
Total	Histopathology	102	100%

Accuracy, sensitivity and positive predictive value of ultrasound

aOn **?** statistical analysis, it was found that ultrasonography had 98.02% positive predictive value (PPV), 99% sensitivity and 97.06 % accuracy [Table 5].

Table 5: Diagnostic validity of sonography.

		Gold standard		Total
		Positive	Negative	
US diagnosis	Positive	99	2	101
	Negative	1	0	1
	Total	100	2	102
Statistical analysis		Value	95% CI	
Sensitivity		99.00%	94.55% to 99.97%	
Disease prevalence		98.04%	93.10% to 99.76%	
Positive Predictive Value		98.02%	97.98% to 98.06%	
Accuracy		97.06%	91.64% to 99.39%	

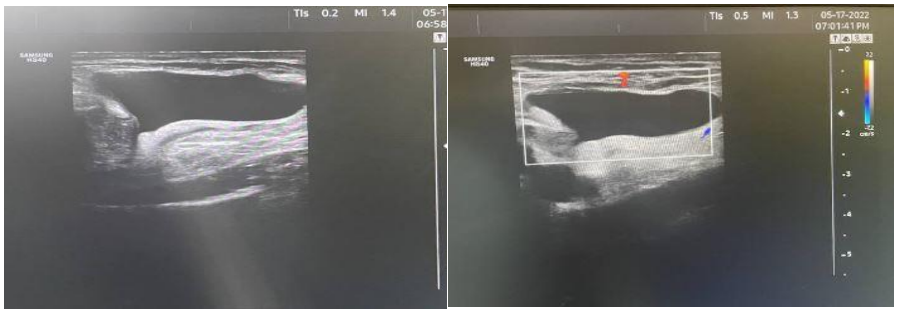

Figure 1: A 46-year-old female presents with RT inguinal swelling; superficial US reveals a cystic lesion in the RT groin, and the speech bubble look is typical of a hydrocele of the canal of Nuck, which is surgically confirmed (adapted from AL-Yarmouk Teaching Hospital).

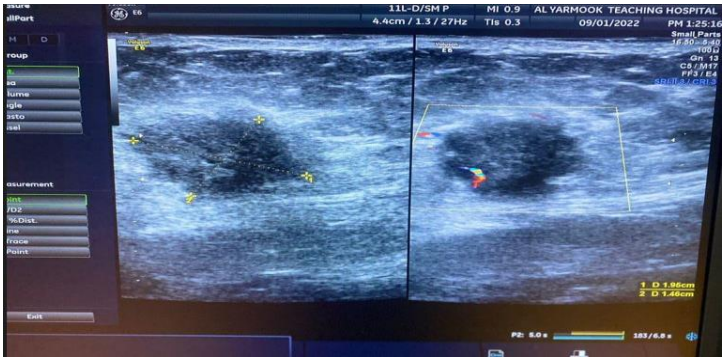

Figure 2: A 38-year-old female presented with a left lower abdominal mass at the site of a previous CS; US examination revealed typical abdominal wall endometriosis features: a hypoechoic nodule with fibrotic spots, speculated margins, and an inflammatory hyperechoic ring that circumscribes almost the entire lesion, with the typical single vascular pedicle entering the mass at the periphery. There is no vascularity in the center. (Adapted from AL-Yarmouk Teaching Hospital) Histopathologically confirmed endometriosis.

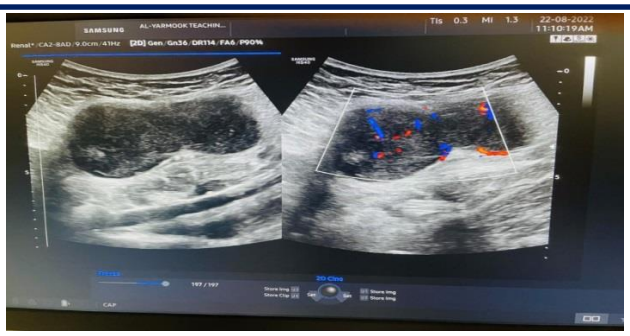

Figure 3: A 47-year-old woman arrived with a left Para central abdominal tumor. Abdominal ultrasound reveals a huge well-defined bilobed hypoechoic solid mass within the left rectus muscle, with internal vascularity visible in color Doppler. Adapted from AL-Yarmouk Teaching Hospital, histopathologically confirmed to be a desmoid tumor.

DISCUSSION:

A total of 102 individuals with various anterior abdominal wall lesions were included in this investigation. The majority of instances (32 patients, 31.38%) displayed sonographic characteristics of various forms of hernias. Inguinal hernia was the most prevalent form (14 instances), followed by ventral hernia (11 occurrences). The findings are congruent with the findings of Mandi et al.[8], who included 50 instances with abdominal wall lesions, 20 of which were inguinal hernias. Male patients had a higher incidence of hernia in this research. This is consistent with the findings of the Ruhl and Everhart [9] research, which revealed that the cumulative incidence of inguinal hernia was greater in males than in women; however, the findings varied with those of the Devareddy et al. [10] study, which found female preponderance.

The clinical diagnosis of inguinal hernia is frequently correct, as evidenced by our study, in which 18 individuals were classified as having a hernia by clinical examination although ultrasonography revealed only 14 cases. This disagreement occurred in four cases; they were clinically identified as inguinal hernias, but ultrasound investigation revealed two cases of undescended testes and two cases of canal of Nuck hydrocele, both of which were surgically proven. This has the potential to strengthen the function of ultrasonic examination. The findings are consistent with the findings of Baz et al. [11], who discovered one instance of hydrocele of the canal of Nuck among 32 cases of inguinal hernias.

Sonographic diagnosis of scar endometriosis was unreliable in one case, which was later revealed to be a suture granuloma on histology. This finding is consistent with recent investigations on ultrasonography characteristics of abdominal wall endometriosis undertaken by Francica G [12], Hensen JH [13].

11 instances of anterior abdominal wall masses with sonographic signs of subcutaneous lipoma were associated with positive histological findings. This observation is consistent with the description of lipoma provided by Devareddy et al [10].

According to histology findings, this study included two cases of epidermal inclusion cysts with sonographic characteristics of a circumscribed round or ovoid moderately hyperechoic lesion with posterior through transmission and no internal Doppler flow. Internal linear echogenic reflectors with a narrow hypoechoic rim can be seen on occasion. This observation is consistent with Hee Kyung Kim et al.'s findings.[14]

Four instances were reported to show sonographic signs of a desmoid tumor out of 24 cases that presented as non-specific abdominal wall masses. Three of these were verified as desmoid tumors on histology, while one instance was discovered to be rectus sheath hematoma in a patient on anticoagulant medication. This discovery is consistent with the findings of a research conducted by Mandi et al[8], who found two cases of desmoid tumors by US but one of them was proved to be a sarcoma on histology.

The US detected anterior abdominal wall masses and mass-like lesions with an overall estimated sensitivity and accuracy of 99% and 97.06%, respectively. This finding is consistent with those of Mandi et al.[8] and Baz et al.[11], who investigated the diagnostic accuracy of high-resolution ultrasound in the assessment of abdominal wall masses and mass-

like lesions, as well as providing an overview of the sonographic appearances of various abdominal wall pathologies.

We demonstrated an overall correlation of sonographic observations with surgical and histological findings with a positive prediction value (efficacy) of 98.02%. High resolution sonographic observations were associated with surgical or histological results with a positive predictive value (efficacy) of 97.4% and 97.7%, respectively, in line with study done by Devareddy et al. [(10)] and Mandi et al. [(8)].

Limitations:

Ultrasound is less detailed than other imaging modalities in giving details of deep structures and the connection of masses to anatomical fascial planes, particularly in obese individuals.

CONCLUSION:

Anterior abdominal wall pathologies are more common in females than males. Hernias, post-operative collections and endometriosis are the most frequent pathologies in patients presented with anterior abdominal wall swellings. Ultrasonography was reported to have 99% sensitivity, 97.06% accuracy, and 98.02% positive predictive value (PPV) for detecting different anterior abdominal wall abnormalities. Abdominal wall lesions are a frequent clinical symptom. Although there are several possible explanations for abdominal wall masses and mass-like lesions, combining clinical and imaging data may usually result in a correct diagnosis or reduce the scope of the differential diagnosis. However, a few forms of masses still need to be diagnosed by pathologists.

RECOMMENDATIONS:

The current study contained a small number of patients with abdominal wall metastases and desmoid tumors, and the importance of US diagnostics was underestimated, thus we urge more research with a larger number of patients suffering from solid abdominal wall lesions.

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