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High Resolution Sonography in the Detection of Anterior Abdominal Wall Lesions

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ABSTRACT

Objective: To assess the diagnostic accuracy of high-resolution sonography in identifying abdominal wall lesions.

Methodology: This cross-sectional study was conducted at Indus Medical College, Tando Mohammad Khan, from April 2022 to March 2023. Forty consecutive cases of anterior abdominal wall lesions, primarily sourced from the Department of Surgery, were enrolled. All patients underwent systematic examination using high-resolution ultrasonography employing a high-frequency probe (7-12MHz). The main variables of the study were sensitivity, specificity, true positives, and diagnostic accuracy. Surgical and histopathologic findings obtained were meticulously documented and subsequently compared with the USG findings to determine the sonography accuracy. Histopathology served as the gold standard. Data analysis was performed using SPSS version 25.

Results: The mean age was 35.18 ± 2.31 years. Males accounted for 32.5% of the cases, while females accounted for 67.5%. The majority of patients (77.5%) fell within the 20-40 years age group. The most common lesions were incisional hernias (35.0%) and ventral hernias (32.5%). The most common preoperative diagnosis by histopathology was bowel loops, representing 30.0% of cases. Sensitivity and specificity were 72.7% and 71.4%, respectively. The positive predictive value (PPV) was 92.3%, and the negative predictive value (NPV) was 35.7%. The overall accuracy was 72.5%.

Conclusion: High-resolution sonography proves to be a precise diagnostic imaging modality for detecting lesions of the anterior abdominal wall, exhibiting high sensitivity in distinguishing between hernias and cystic or solid abnormalities in the abdominal wall.

Keywords: Anterior Abdominal Wall, High Resolution, Ultrasonography, Histopathology, Lesions.

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Introduction

Lesions in the abdominal wall, particularly in patients with a thick layer of abdominal fat, can mimic intra-abdominal conditions, often manifesting as palpable masses.[1] The diagnostic process is occasionally challenging due to the low specificity of physical findings associated with pathologic processes affecting the abdominal wall.[2] The most common situation necessitating ultrasonography of the abdominal wall is when there is uncertainty regarding a palpable abdominal mass, with the aim of determining whether it is located inside the abdominal cavity or within the abdominal wall. [3,4]

In clinical practice, instances arise where an intra-abdominal mass, initially suspected based on clinical presentation, is subsequently identified within the abdominal wall, while conversely, abdominal wall lesions may be incidentally discovered during abdominal sonography conducted for unrelated reasons.[5]

Additionally, individuals experiencing chronic abdominal pain may require an examination specifically focusing on the abdominal wall, particularly when the presence of a positive Carnett sign indicates that the origin of the pain is likely within the abdominal wall itself.[6,7]

The advent of high-frequency, high-resolution probes in ultrasound examinations now allows for a detailed assessment and differentiation of various layers within the abdominal wall[8], enabling precise identification of abnormalities of abdomen.[9,10] In cases where physical findings in the abdominal wall exhibit low specificity and a suspected lump of abdomen clinically, a positive Carnett's sign often prompts the recommendation for a high-resolution ultrasound examination specifically targeting the abdominal wall for accurate diagnosis.[11]

The anterior abdominal wall is susceptible to a diverse spectrum of pathologies, spanning from uncomplicated fluid collections to hernias and intricate neoplasms; the advent of high-resolution ultrasound and other cross-sectional imaging has markedly transformed the landscape of early detection, thereby revolutionizing treatment options for surgeons.[12] High-resolution ultrasonography (USG) stands out as a superior imaging modality for assessing abdominal wall pathology due to its cost-effectiveness, ready availability, absence of non-ionizing radiation, and commendable accuracy rate.[13]

The proposed study addresses a gap in the current understanding of this topic. By elucidating its role, the research aims to contribute valuable insights for clinicians and radiologists, potentially influencing diagnostic protocols and improving patient care. The study also will also help medical researchers to fulfill the local reference gap on multidisciplinary approach in diagnosis of medically challenging conditions.

Methodology

The study was conducted at Indus Medical College, Tando Mohammad Khan from April 2022 to March 2023. Study was started after ethical approval from hospital ethical board and taken consent from patients. Patients were ensured about their confidentiality of data. Forty consecutive cases of anterior abdominal wall lesions (presence of mass or mass like appearance within anterior abdominal wall), primarily sourced from the Department of Surgery, were systematically examined using high-resolution ultrasonography with a 7-12 MHz high-frequency linear array probe. Patients of all age groups presenting with clinical presentation of lesion of abdominal wall were selected, while those with acute abdomen were excluded. All participants underwent anterior abdominal wall ultrasonography using a 7.0-12.0 MHz high-frequency linear array transducer with color Doppler equipment (Esaote My Lab 50), and pelvic scans were conducted with a 3.5-5.0 MHz transducer when deemed necessary.

High-resolution sonography with color Doppler (7–12 MHz) was employed to critically evaluate all cases, and when necessary, pathological or surgical confirmation was sought. Surgical and histopathologic findings obtained were meticulously documented and subsequently compared with the USG findings to determine the sonography accuracy. Patients with a strong clinical suspicion of lesions of anterior abdominal wall were assessed in the Department of Radio-diagnosis using high-resolution Ultrasonography, employing a high-frequency linear array probe.

The diagnostic accuracy of lesions of abdominal wall was assessed through ultrasonography and color Doppler, comparisons made to histopathological and operative findings, employing diagnostic validity tests such as specificity, sensitivity and predictive (positive, negative values. Data analysis was done on SPSS version 27, after calculating mean ± SD, frequency and percentages 2x2 contingency table was drawn to calculated positive and negative predictive values and accuracy.

Results

Overall, 40 patients were included in this study with mean age 35.18±2.31 years. There were 13 (32.5%) males and 27 (67.5%) females. Majority of the patients i.e. 31 (77.5%) had between 20-40 years of age group. The most common lesions were incisional hernias 14 (35.0%) and ventral hernias 13 (32.5%). (Table I).

Table. I: Sonography findings abdominal wall

Lesions	N	%
Hernias (Incisional)	14	35.0
Hernias (Ventral)	13	32.5
Lipoma of Ant-abdominal wall	2	5.0
Haematoma of Ant-abdominal wall	2	5.0
Desmoidtumor	1	2.5
Dermoid cyst	1	2.5
Seroma (Post-operative)	1	2.5
Pyomyositis external oblique	1	2.5
Neuro-fibroma	1	2.5
Melanoma (metastatic)	1	2.5
Abscess Resolving	1	2.5
Sarcoma of Abdominal wall	1	2.5
Others	1	2.5

The most common preoperative diagnosis by histopathology was bowel loops as 12 (30.0%). (Table II). Diagnostic validity was shown in table III. Sensitivity and specificity were 72.7% and 71.4%, respectively. Positive predictive value (PPV) and negative predictive value

(NPV) were 92.3% and 35.7% respectively. Whereas, the overall accuracy was 72.5%.

Table. II: Histopathological and preoperative diagnosis of lesions of abdominal wall.

Histopathology	N	%
Bowel loops	12	30.0
Not done	9	22.5
Desmoid fibromatosis	2	5.0
Linea alba defect	3	7.5
Lipoma	2	5.0
Metastatic melanoma	1	2.5
Neurofibroma	7	17.5
Fat Omental	1	2.5
Abscess	1	2.5
Others	2	5.0

Table III: Validity of diagnostic measures of high-resolution sonography.

Test	Positive	Negative	Total	p-value
Positive	24 (72.7)	2 (28.6)	26 (75.0)	
Negative	9 (27.3)	5 (71.4)	14 (25.0)	0.224
Total	33 (100.0)	7 (100.0)	40 (100.0)	

Discussion

Abdominal wall lesions are frequently encountered in clinical and radiological examinations, often presenting with nonspecific clinical findings; surprisingly, some suspected intra-abdominal masses may originate from the abdominal wall itself.[14] Ultrasound is the preferred imaging modality for evaluating these lesions due to its widespread availability, noninvasiveness, low cost, and ability to provide high spatial resolution of the abdominal wall layers.[15]

In this study lesion was detected in middle age patients and in females as mean age of patients was 35.18±2.31 years 32.5% males and 67.5% females. A study was conducted by Arpita et al[16] in 2019 on this topic, most of patients 60% were in between age 20-40 years and inguinal hernia was most common presentation in 60% of cases and sensitivity of 100%. Another study was conducted by Babu et al[17] assessing the utility of high-resolution ultrasound for evaluating abdominal wall lesions reported similar findings, 50 patients were included, comprising 66.7% females and 33.3% males.

Our findings also supported by Jayaram et al[18] who conducted a comprehensive study involving 348 patients 43.1% males and 56.9% females to assess the effectiveness of ultrasound scanning in diagnosing equivocal ventral hernias, comparing the results to operative findings. This resulted in a sensitivity rate of 91.8%, indicating the proportion of true positive cases correctly identified, and a positive predictive value of 97.8%, representing the accuracy of positive predictions made by the diagnostic test. We also agreed with recent study by Devareddy et al[19], it was reported that a hernia is the most common lesion, accounting for 70% of cases.

Another study by Baz et al[20] concluded that high-resolution ultrasound demonstrated exceptional diagnostic performance, achieving 100% accuracy across abdominal wall lesions when compared to operative, histopathological, and CT findings. Specifically, in hernia cases, it exhibited perfect diagnostic values, all registering at 100%. Mandi et al[21] also conducted a study and reported that high-resolution ultrasound (HRUSG) stands out as a noninvasive and readily accessible diagnostic method, offering a cost-effective solution with minimal patient discomfort, while demonstrating an impressive 97.7% precision in diagnosing abdominal wall lesions.

In accordance with our study El-Sayed et al[22] conducted a study involving 50 patients, revealing ventral hernia as the predominant abdominal wall lesion, and emphasized the important role of ultrasonography in assessing various abdominal wall lesions, particularly when complications were suspected, underscoring its significance as a confirmatory diagnostic tool in cases where histopathology results were inconclusive.

Regarding diagnostic strength of study, a study was conducted by Poureisa et al[23] on comparison between preoperative sonographic and final pathologic diagnoses and demonstrated a 77% accuracy rate, with correct identification of ovarian cystic teratoma in 71% of cases (sensitivity 71%, specificity 98%) and ovarian malignancy in 70% of cases (sensitivity 70%, specificity 98.5%), while 14 out of 79 cases were misread, and 4 cases were entirely missed on sonograms. Another study by Naeem et al[24] reported that abdominal wall ultrasonography is a versatile and valuable tool in clinical practice. Its ability to provide real-time imaging, its non-invasive nature, and its usefulness in various medical scenarios make it an important diagnostic modality.

In cases where surgery is necessary, abdominal wall ultrasonography can contribute to preoperative planning by providing detailed information about the location and extent of abnormalities. This can lead to more precise surgical interventions.

Conclusion

High-resolution sonography proves to be a precise diagnostic imaging modality for detecting anterior abdominal wall lesions, exhibiting high sensitivity in

distinguishing between hernias and cystic or solid abnormalities in the abdominal wall.

Limitations: Findings from a specific population or clinical setting may not be easily generalizable to other populations or settings. This is especially relevant if the study was conducted in a specialized medical center with unique patient characteristics. The study may not account for potential interobserver variability in the interpretation of sonographic images, especially if multiple radiologists are involved in the analysis.

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