International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

Original Research Article *DOI: 10.61336/im/26-06-32*

Diagnostic Accuracy of High-Resolution Ultrasonography in the Evaluation of Anterior Abdominal Wall Lesions at a Tertiary Care Hospital in Odisha: A Hospital-Based Observational Study

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Received: 25-04-2026
Revised: 07-05-2026
Accepted: 22-05-2026
Published: 06-06-2026

Abstract

Background: Anterior abdominal wall lesions encompass a wide spectrum of conditions ranging from simple fluid collections and hernias to neoplastic lesions. Clinical differentiation between abdominal wall and intra-abdominal pathologies is often challenging because of nonspecific physical findings. High-resolution ultrasonography (HRUSG) has emerged as an important diagnostic modality due to its accessibility, non-invasive nature, and high diagnostic accuracy. ***Objective:*** To evaluate the spectrum of anterior abdominal wall lesions and assess the diagnostic accuracy of high-resolution ultrasonography using a high-frequency linear array probe in their diagnosis. ***Methods:*** A hospital-based descriptive observational study was conducted in the Department of Radiodiagnosis at SCB Medical College and Hospital, Cuttack, Odisha, over a period of two years from January 2016 to December 2017. A total of 75 clinically suspected cases of anterior abdominal wall lesions were included. All patients underwent high-resolution ultrasonographic evaluation using a 7–12 MHz high-frequency linear array transducer with colour Doppler. Sonographic findings were compared with surgical and histopathological diagnoses, wherever applicable, to determine diagnostic validity. Statistical measures including sensitivity, specificity, predictive values, and diagnostic accuracy were calculated. ***Results:*** The majority of patients belonged to the 20–40 years age group (44%), followed by those aged >40 years (36%). Incisional hernia was the most common lesion identified (42.7%), followed by ventral hernia (14.7%) and anterior abdominal wall lipoma (9.3%). Histopathological or post-operative correlation was available in 68 (90.7%) cases. High-resolution ultrasonography demonstrated excellent agreement with final diagnosis, with a sensitivity of 97.0%, specificity of 100%, positive predictive value of 100%, negative predictive value of 50.0%, and an overall diagnostic accuracy of 97.1%. ***Conclusion:*** High-resolution ultrasonography is a highly accurate and reliable imaging modality for evaluating anterior abdominal wall lesions. It effectively differentiates hernias from cystic and solid lesions and helps distinguish abdominal wall abnormalities from intra-abdominal pathologies. Given its non-invasive nature, cost-effectiveness, lack of ionizing radiation, and high diagnostic accuracy, HRUSG should be considered a first-line imaging modality in the assessment of anterior abdominal wall lesions.

Keywords: Anterior abdominal wall lesions; High-resolution ultrasonography; Incisional hernia; Ventral hernia; Colour Doppler; Diagnostic accuracy; Odisha

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INTRODUCTION

Anterior abdominal wall lesions frequently mimic intra-abdominal pathologies and commonly present as palpable masses, particularly in individuals with a thick abdominal wall or increased subcutaneous fat. Differentiating abdominal wall lesions from intra-abdominal conditions often poses a diagnostic challenge because clinical examination findings are frequently nonspecific. In many cases, ultrasonographic evaluation of the abdominal wall becomes necessary to determine whether a suspected mass originates from the abdominal wall or the abdominal cavity. Occasionally, a clinically suspected intra-abdominal lesion is found to arise from the abdominal wall, while in other instances, abdominal wall abnormalities are detected incidentally during sonographic examination performed for unrelated indications. Furthermore, evaluation of the abdominal wall is particularly important in patients presenting with chronic abdominal pain, especially when a positive Carnett's sign suggests an abdominal wall origin of pain.[1,2]

The assessment of anterior abdominal wall pathology remains challenging for both clinicians and radiologists because of the wide spectrum of diseases and the availability of multiple imaging modalities for evaluation. Diagnostic approaches

range from plain abdominal radiography to advanced imaging techniques such as ultrasonography (USG), computed tomography (CT), and magnetic resonance imaging (MRI).

The introduction of high-frequency, high-resolution ultrasonographic probes has substantially improved the evaluation of abdominal wall lesions by allowing detailed visualization of the individual layers of the abdominal wall. High-resolution sonography can accurately determine whether a lesion is located within the abdominal wall or inside the abdominal cavity, thereby improving diagnostic confidence. Since physical examination findings alone have low specificity, sonographic evaluation is frequently recommended, particularly in patients with a positive Carnett's sign or clinically suspected abdominal wall pathology.

High-resolution ultrasonography has emerged as a preferred imaging modality for evaluating anterior abdominal wall lesions because of its accessibility, cost-effectiveness, absence of ionizing radiation, and high diagnostic accuracy. A broad spectrum of pathological conditions may involve the anterior abdominal wall, ranging from simple fluid collections and hernias to complex neoplastic lesions. Early and accurate diagnosis using high-resolution ultrasonography, often complemented by cross-sectional imaging, has significantly improved clinical decision-making and surgical management. Therefore, the present study was undertaken to evaluate the spectrum of anterior abdominal wall lesions and to assess the diagnostic accuracy of high-resolution sonography using a high-frequency linear array probe in the diagnosis of anterior abdominal wall lesions.

MATERIALS AND METHODS

A hospital-based descriptive observational study was conducted in the Department of Radiodiagnosis at SCB Medical College and Hospital, Cuttack, Odisha, over a period of two years from January 2016 to December 2017. A total of 75 consecutive cases clinically suspected to have anterior abdominal wall lesions and referred primarily from the Departments of Surgery and General Medicine were included in the study. All patients underwent evaluation using high-resolution ultrasonography (HRUSG) with a high-frequency linear array transducer (7–12 MHz).

Inclusion Criteria

1. Patients of all age groups with clinical manifestations suggestive of anterior abdominal wall lesions.
2. Patients referred for radiological evaluation of suspected anterior abdominal wall pathology.

Exclusion Criteria

1. Patients presenting with features of acute abdomen requiring emergency surgical intervention.
2. Patients unwilling to participate or with incomplete clinical details.

Method of Data Collection

All enrolled patients underwent ultrasonographic examination of the anterior abdominal wall using a 7–12 MHz high-frequency linear array transducer coupled with colour Doppler imaging. When required, additional abdominal or pelvic scans were performed using a 3.5–5 MHz convex transducer to assess deeper extension or intra-abdominal involvement.
All lesions were critically evaluated using high-resolution sonography and colour Doppler for lesion characterization, vascularity, size, extent, and anatomical localization. Surgical findings and histopathological examination reports, wherever available, were recorded and compared with sonographic findings to determine the diagnostic performance of high-resolution ultrasonography.

Method of Examination

Patients referred to the Department of Radiodiagnosis with clinical suspicion of anterior abdominal wall lesions underwent systematic ultrasonographic examination using high-resolution sonography with a high-frequency linear probe (7–12 MHz). Colour Doppler assessment was performed whenever necessary to assess lesion vascularity and differentiate inflammatory from neoplastic pathology.

Statistical Methods

The diagnostic validity of high-resolution ultrasonography in anterior abdominal wall lesions was assessed by comparison with operative and histopathological findings. Diagnostic parameters including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy were calculated.

RESULTS

The present study included 75 clinically suspected cases of anterior abdominal wall lesions evaluated by high-resolution ultrasonography. The highest proportion of patients belonged to the 20–40 years age group (44%), followed by patients aged more than 40 years (36%), while younger individuals aged less than 20 years constituted 20% of cases (Table 1).

Among the clinically suspected anterior abdominal wall lesions, the most common indication for high-resolution sonographic evaluation was incisional hernia, followed by ventral hernia and anterior abdominal wall swelling/lump, which often represented non-specific clinical diagnoses and were later characterized accurately on sonography.

Table 1: Age-wise Distribution of Anterior Abdominal Wall Lesions (n = 75)

Sl. No.	Age Group	No. of Cases	Percentage
1	<20 years	15	20.0
2	20–40 years	33	44.0
3	>40 years	27	36.0
Total		**75**	**100**

Table 2: High-Resolution Sonographic Diagnosis of Anterior Abdominal Wall Lesions (n = 75)

Ultrasound Diagnosis	No.	%
Incisional hernia	32	42.7
Ventral hernia	11	14.7
Anterior abdominal wall lipoma	7	9.3
Anterior abdominal wall hematoma	5	6.7
Desmoid tumour	3	4.0
Dermoid cyst	3	4.0
Post-operative seroma	3	4.0
External oblique pyomyositis	2	2.7
Neurofibroma	2	2.7
Metastatic deposits	1	1.3
Resolving abscess	2	2.7
Abdominal wall sarcoma	1	1.3
Others	3	4.0
Total	**75**	**100**

High-resolution ultrasonography most frequently detected incisional hernia, accounting for 32 cases (42.7%), followed by ventral hernia in 11 cases (14.7%). Other lesions included lipoma, hematoma, post-operative seroma, dermoid cyst, desmoid tumour, inflammatory lesions, and rare soft tissue neoplasms (Table 2).

Table 3: Histopathological / Post-Operative Diagnosis of Anterior Abdominal Wall Lesions (n = 75)

Histopathology/Post-operative Findings	No.	%
Bowel loops through fascial defect	28	37.3
Omental fat / bowel loops	10	13.3
Lipoma	7	9.3
Dermoid cyst	3	4.0
Desmoid fibromatosis	3	4.0
Linea alba defect	3	4.0
Abscess	2	2.7
Neurofibroma	2	2.7
Metastatic deposits	1	1.3
Not done	7	9.3
Others	9	12.0
Total	**75**	**100**

Histopathological or post-operative confirmation was obtained in 68 out of 75 cases (90.7%) whenever indicated. Sonographic diagnosis correlated accurately with surgical or histopathological findings in the majority of patients, yielding an overall diagnostic accuracy of 97.1% (Table 4).

Table 4: Diagnostic Validity of High-Resolution Sonography

Test	Positive	Negative	Total
Positive	64	0	64
Negative	2	2	4
Total	**66**	**2**	**68**

Sensitivity = 97.0% , Specificity = 100% , Positive Predictive Value (PPV) = 100% , Negative Predictive Value (NPV) = 50.0% , Diagnostic Accuracy = 97.1%

DISCUSSION

The present study evaluated 75 cases of anterior abdominal wall lesions over a two-year period at SCB Medical College and Hospital, Cuttack, Odisha, with emphasis on the diagnostic utility of high-resolution ultrasonography (HRUSG). Literature focusing specifically on anterior abdominal wall lesions in the Indian setting remains limited, particularly from tertiary care institutions in eastern India. The present study highlights the role of HRUSG in the characterization and diagnosis of various anterior abdominal wall pathologies and demonstrates its high diagnostic performance in routine clinical practice.

Congenital anterior abdominal wall defects such as omphalocele, gastroschisis, cloacal exstrophy, and prune belly syndrome are generally detected during antenatal ultrasonography, particularly in the second trimester (18–24 weeks of gestation). Although such lesions can be evaluated using low-frequency probes during fetal imaging, the present study focused primarily on acquired anterior abdominal wall lesions assessed using high-frequency linear transducers (7–12 MHz). Therefore, congenital lesions identified during antenatal scans were not included in the study population.

Patients were broadly categorized into three age groups: <20 years, 20–40 years, and >40 years. The majority of cases in the present study belonged to the 20–40 years age group (44%), followed by individuals aged more than 40 years (36%). Similar observations have been reported in previous studies, where abdominal wall lesions, particularly hernias, were more commonly encountered among young and middle-aged adults due to increased physical activity, prior surgical interventions, and greater healthcare-seeking behavior. The predominance of lesions in this economically productive age group may also reflect increased awareness and early reporting of symptoms.

Among the clinically suspected anterior abdominal wall lesions, incisional hernia was the most common indication for high-resolution sonographic evaluation and represented the most frequently diagnosed lesion (42.7%), followed by ventral hernia (14.7%). HRUSG proved particularly useful in differentiating clinically nonspecific abdominal wall swellings and lumps, which were subsequently characterized accurately through sonographic findings and, where necessary, histopathological confirmation. This observation reinforces the importance of ultrasonography in lesion characterization and localization, often outperforming clinical examination alone.

The sonographic diagnosis of incisional and ventral hernias was relatively straightforward because high-resolution sonography clearly demonstrated fascial defects, reducibility, and hernial contents in real time. Additionally, the use of colour Doppler facilitated assessment of vascular compromise and helped distinguish strangulated from uncomplicated hernias. Similar findings have been documented in earlier studies.[3–7]

Lipomas constituted another important category of anterior abdominal wall lesions in the present study. All lipomatous lesions showed characteristic sonographic appearances, including well-defined margins, oval morphology, and iso- to mildly hyperechoic echotexture relative to surrounding musculature. HRUSG demonstrated high accuracy in identifying these lesions, thereby minimizing unnecessary invasive procedures.

Other less frequent lesions included desmoid tumours, dermoid cysts, pyomyositis, resolving abscesses, neurofibromas, metastatic lesions, and abdominal wall sarcoma. Desmoid tumours typically appeared as well-defined hypoechoic masses with increased internal vascularity on colour Doppler, particularly in patients with previous abdominal surgery, findings consistent with previous reports.

Histopathological and post-operative correlation was available in the majority of cases (90.7%), and sonographic findings demonstrated excellent agreement with final diagnosis. In the present study, high-resolution ultrasonography achieved an overall diagnostic accuracy of 97.1%, with high sensitivity and specificity. These findings suggest that HRUSG provides diagnostic reliability comparable to surgical and histopathological evaluation for most anterior abdominal wall lesions.

Hernias continue to represent the most common abdominal wall pathology encountered in sonographic practice. Depending on anatomical location and contents, they may demonstrate varying sonographic appearances. High-frequency transducers

allow excellent visualization of fascial defects and herniated contents, while real-time imaging enables dynamic assessment of reducibility. Ventral hernias are typically observed in regions of weakened linea alba and frequently contain omental fat, although bowel loops may occasionally be present.[3,4]

Incisional hernias are recognized as a common delayed complication of abdominal surgery and may occur following both open and laparoscopic procedures. Many patients present within the first postoperative year, while others remain asymptomatic and are incidentally detected during imaging. Sonography plays an essential role in confirming the diagnosis, assessing hernia contents, and monitoring the integrity of mesh repair when present.[5–7]

Although less frequently encountered, Spigelian and inguinal hernias may occasionally present diagnostic difficulties clinically. High-resolution sonography, especially when combined with colour Doppler imaging, significantly improves lesion detection and characterization by accurately delineating anatomical defects and vascular landmarks.[8–11]

CONCLUSION

High-resolution ultrasonography is a highly effective and reliable imaging modality for evaluating anterior abdominal wall lesions. It demonstrates excellent diagnostic accuracy in differentiating hernias from cystic and solid abdominal wall lesions and in distinguishing abdominal wall pathologies from intra-abdominal abnormalities. The advantages of HRUSG include its non-invasive nature, absence of ionizing radiation, cost-effectiveness, widespread availability, reproducibility, and high diagnostic accuracy. Therefore, high-resolution ultrasonography should be considered a first-line imaging modality in the evaluation of anterior abdominal wall lesions at tertiary care settings such as SCB Medical College and Hospital, Cuttack, Odisha.

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