DIAGNOSTIC ACCURACY OF ULTRASOUND IN DIAGNOSING OF MESENTERIC CYST TAKING HISTOPATHOLOGY AS GOLD STANDARD

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Abstract

Background: *Mesenteric cysts are rare, fluid-filled lesions that present diagnostic challenges. While histopathology is the gold standard for diagnosis, it is invasive and not always feasible. With advancements in ultrasound technology, there is increasing interest in its use as a non-invasive diagnostic tool. However the evidence was limited to international studies and local study on it. This study was designed to evaluate ultrasound's diagnostic accuracy compared to histopathology.*

Objective: *To determine the diagnostics accuracy of ultrasound in diagnosing of mesenteric cyst taking histopathology as gold standard.*

Study Settings: *This study was conducted at the Department of Diagnostic Radiology, The Children's Hospital, Lahore, over 6 months period from 03/07/2024 to 02-01-2025.*

Material and Methods: *After ethical approval, 100 eligible patients were enrolled with informed consent. Ultrasound exams were performed using Esoate and Samsung machines, with transducers of 7.5-12 MHz linear and 3.5 MHz curved array. A graded compression technique was applied to detect mesenteric vessels. Histopathological findings were the gold standard, with all exams conducted by one experienced radiologist and surgeries by one surgical team to reduce bias. Data analysis in SPSS included descriptive statistics, sensitivity, specificity, PPV, NPV, and stratified analysis for age, gender, cyst size, and weight.*

Results: *The study included 100 participants with a mean age of 8.26 ± 2.75 years, 54% boys and 46% girls. Ultrasound detected mesenteric cysts in 53 participants (53%), and histopathology confirmed cysts in 55 participants (55%). Ultrasound sensitivity was 83.64%, specificity 84.44%, and accuracy 84.00%.*

Conclusion: *In conclusion, ultrasound proved to be highly accurate for detecting mesenteric cysts, with a sensitivity of 83.64%, specificity of 84.44%, and overall accuracy of 84.00%. The results highlight ultrasound as a reliable diagnostic tool, showing consistent performance across various subgroups like age, gender, cyst size, and weight.*

INTRODUCTION

Mesenteric cysts, cystic swellings located in the small bowel or colon's mesentery, are rare, benign intraabdominal tumors that can affect individuals of all ages.[1] These cysts typically present with painless, often uniform abdominal enlargement and are less commonly seen in children, with incidences of 1/100,000 in adults and 1/20,000 in children. The female-to-male ratio for mesenteric cysts is 2:1.[2,3] Due to their often asymptomatic nature, mesenteric cysts are frequently discovered incidentally during imaging for other conditions.[4] Although they can cause abdominal discomfort, nausea, vomiting, and distension, these cysts do not exhibit distinct clinical or radiological features, leading to diagnostic challenges.[4,5]

There are five primary types of mesenteric cysts, including chylolymphatic, simple (mesothelial), heterogeneous, urogenital remnant, and dermoid (teratomatous) cysts. Depending on their size, some mesenteric cysts may form palpable abdominal masses.[6] Despite their rarity, the accurate diagnosis of these cysts is essential, particularly in distinguishing them from malignant lesions. Ultrasound (USG) is the most common and effective imaging modality for evaluating mesenteric cysts. It is cost-effective, non-invasive, and can be repeated to monitor cyst changes over time.[7,8]

A critical aspect of mesenteric cyst diagnosis involves distinguishing benign cysts from malignant ones, as the malignancy risk is estimated at about 3%. Therefore, the role of imaging, especially ultrasound, is invaluable in planning appropriate treatment. Given the potential risks of biopsy, such as damage to the cyst wall and perforation, it is typically not recommended. Proper evaluation with imaging ensures the safe and accurate management of mesenteric cysts.[8,9]

Mokarabina et al. (2020) found 3(12%) cases of sonographically diagnosed mesenteric cyst, the sensitivity of ultrasonogram is 96.30% and the specificity is 60.00%. The positive predictive value is 92.86% and negative predictive value is 75.00% and the overall diagnostic accuracy of this series is 90.62%.[10] Yashi et al. (2022) reported sensitivity and specificity of USG 73.7% and 80.3% respectively whereas prevalence of myenteric cysts was 45.5%.[11]

Ultrasound is a procedure that is both hardware and operator dependent, making it essential to assess its diagnostic accuracy with the available equipment and skillset. However, existing evidence is limited, with only a few international studies on this topic. To the best of the candidate's knowledge, no other local or international publications exist addressing this issue, highlighting the need for the present study. This study aimed to determine the diagnostic accuracy of ultrasonography in detecting mesenteric cysts.

MATERIAL AND METHODS

This cross-sectional study was conducted at the Department of Diagnostic Radiology at The Children's Hospital and University of Child Health Sciences, Lahore, to evaluate the diagnostic accuracy of ultrasound in detecting mesenteric cysts in children, while taking histopathology findings as the gold standard. Mesenteric cysts were identified on ultrasound as a palpable mass in the right iliac fossa, measuring less than 4 cm in size, with a wall thickness of less than 3 mm, and with or without calcifications. The cysts were also required to show no necrosis or contrast enhancement. Histopathological diagnosis was made when the cyst wall was lined by flattened epithelium, with no granuloma features. The diagnostic accuracy of ultrasound was assessed by evaluating its ability to detect mesenteric cysts, defined in terms of true positives (TP), true negatives (TN), false positives (FP), and false negatives (FN). A true positive was when both ultrasound and surgery detected the mesenteric cyst, while a true negative was when neither ultrasound nor surgery detected the cyst. A false positive occurred when ultrasound diagnosed a mesenteric cyst, but surgery found no cyst, and a false negative was when ultrasound missed the cyst, but surgery confirmed its presence. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated to evaluate ultrasound's performance. A non-probability, consecutive sampling technique was used, with a sample size of 100 patients calculated based on a 95% confidence interval and a 13% margin of error, assuming a sensitivity of 73.7% and specificity of 80.3%, and a mesenteric cyst prevalence of 45.5%.[11] criteria included children aged 1 to 12 years with a palpable abdominal mass, referred for abdominal

ultrasound and later surgical exploration. Exclusion criteria comprised patients with abdominal malignancy, previous upper abdominal surgery, abdominal trauma, renal issues, congenital abnormalities, or life-threatening co-morbidities. Upon ethical approval, 100 eligible patients were enrolled, with written informed consent obtained. Ultrasound examinations were performed using Esoate and Samsung ultrasound machines with a 7.5-12 MHz linear transducer and a 3.5 MHz curved array transducer. The examinations were conducted in the supine position, and a graded compression technique was applied to detect mesenteric vessels. The findings from ultrasound were labeled based on the operational definition, and surgical findings served as the gold standard. All ultrasound exams were performed by a single experienced radiologist, and surgeries were carried out by one surgical team to minimize bias. Data was analyzed using SPSS version 20. Descriptive statistics summarized age, weight, and cyst size, while categorical variables such as gender, ultrasound, and surgical findings were presented as frequencies and percentages. Sensitivity, specificity, PPV, NPV, and diagnostic accuracy were calculated, and stratified analysis based on age, gender, cyst size, and weight was performed to address effect modifiers. After post-stratification, diagnostic performance was recalculated.

RESULTS

The study included 100 participants, with a mean age of 8.26 ± 2.75 years. Among them, 34% were aged between 1 and 6 years, while 66% were aged between 7 and 12 years. In terms of gender distribution, 54% of the participants were boys and 46% were girls. The mean cyst size was 1.99 ± 0.82 cm, with 67% of participants having cysts ranging from 1 to 2 cm, and 33% having cysts measuring 3 cm. The mean weight

of the participants was 29.06 ± 9.29 kg, with 49% weighing up to 25 kg and 51% weighing more than 25 kg. Data is given in Table 1. In this study, ultrasound detected mesenteric cysts in 53 participants (53.0%), while 47 participants (47.0%) were not diagnosed with a mesenteric cyst using ultrasound. Histopathology, which served as the gold standard for diagnosis, confirmed mesenteric cysts in 55 participants (55.0%), while 45 participants (45.0%) did not have a mesenteric cyst according to histopathological findings. Data is given in table 2. Histopathology confirmed mesenteric cysts in 50.0% of participants aged 1-6 years (17/34) and 57.6% of those aged 7-12 years (38/66), with no significant age-related difference (p = 0.47). Among boys, 57.4% (31/54) had confirmed cysts, compared to 52.2% of girls (24/46), with no significant gender difference (p = 0.600). Cyst size did not show a significant difference either, with 55.2% (37/67) of participants with cysts 1-2 cm and 54.5% (18/33) with 3 cm cysts confirmed (p = 0.949). Finally, 49.0% of participants weighing up to 25 kg (24/49) and 60.0% weighing more than 25 kg (31/51) had confirmed cysts, with no significant difference in weight groups (p = 0.236). Data is given in Table 3.

Out of 100 participants, ultrasound correctly identified 46 true positives and 38 true negatives, while misidentifying 7 false positives and missing 9 false negatives. The diagnostic performance showed sensitivity of 83.64%, specificity of 84.44%, and accuracy of 84.00%, with a disease prevalence of 55% and predictive values of 86.79% (PPV) and 80.85% (NPV). Data is given in Table 4. The diagnostic accuracy of ultrasound for mesenteric cysts, using histopathology as the gold standard, was stratified by age, gender, cyst size, and weight. In all subgroups, similar diagnostic accuracy was observed. Data is given in Table 5-8, respectively.

Table 1 Demographic Characteristics of Patients with Suspicion of Mesenteric Cyst

Characteristics	Participants (n=100)
Age (years)	8.26±2.75
• 1-6 years	34 (34.0%)
• 7-12 years	66 (66.0%)
Gender	
• Boy	54 (54.0%)
• Girl	46 (46.0%)

Cyst Size (cm)	1.99±0.82
• 1-2 cm	67 (67.0%)
• 3 cm	33 (33.0%)
Weight (kg)	29.06±9.29
• Upto 25 kg	49 (49.0%)
• >25 kg	51 (51.0%)

Table 2 Frequency of Mesenteric Cyst upon Ultrasound and Histopathology

Modality	Mesenteric Cyst	Frequency (n)	Percent (%)
Ultrasound	Yes	53	53.0 %
	No	47	47.0 %
	Total	100	100.0 %
Histopathology	Yes	55	55.0 %
	No	45	45.0 %
	Total	100	100.0 %

Table 3 Comparison of Histopathology confirmed Mesenteric Cyst Across Various Subgroups of Patients included in the Study

Subgroups	n	Histopathology Confirmed Mesenteric Cyst n (%)	P-value
Age (years)			
• 1-6 years	34	17 (50.0%)	0.47
• 7-12 years	66	38 (57.6%)	
Gender			
• Boy	54	31 (57.4%)	0.600
• Girl	46	24 (52.2%)	
Cyst Size (cm)			
• 1-2 cm	67	37 (55.2%)	0.949
• 3 cm	33	18 (54.5%)	
Weight (kg)			
• Upto 25 kg	49	24 (49.0%)	0.236
• >25 kg	51	31 (60.0%)	

Chi-square test, observed difference was statistically insignificant

Table 4 Contingency Table to Determine Diagnostic Performance of Ultrasound in Diagnosing Mesenteric Cyst Taking Histopathology as Gold Standard

Ultrasound	Histopathology		Total
	Mesenteric Cyst	No	
Mesenteric Cyst	46[a]	7[c]	53
No	9[b]	38[d]	47
Total	55	45	100

[a]True Positive = 46, [c]False Positive = 7, [b]False Negative = 9, [d]True Negative = 38

Statistic	Formula	Value
Sensitivity	$\dfrac{a}{a+b}$	83.64%
Specificity	$\dfrac{d}{c+d}$	84.44%
Accuracy	$\dfrac{a+d}{a+b+c+d}$	84.00%
Disease prevalence	$\dfrac{a+b}{a+b+c+d}$	55.0%
Positive Predictive Value	$\dfrac{a}{a+c}$	86.79%
Negative Predictive Value	$\dfrac{d}{b+d}$	80.85%

Table 5 Contingency Table to Determine Diagnostic Performance of Ultrasound in Diagnosing Mesenteric Cyst Taking Histopathology as Gold Standard across Age

Age	Ultrasound	Histopathology Mesenteric Cyst	No	Total	Diagnostic Performance
1-6 years (n=34)	Mesenteric Cyst	14	3	17	SN=82.35%, SP=82.35%
	No	3	14	17	PPV=82.35%, NPV=82.35%
	Total	17	17	34	AC=82.35%, PR=50%
7-12 years (n=66)	Mesenteric Cyst	32	4	36	SN=84.21%, SP=85.71%
	No	6	24	30	PPV=88.90%, NPV=79.98%
		38	28	66	AC=84.85%, PR=57.6%

SN= Sensitivity, SP = Specificity, AC = Accuracy, PPV = Positive Predictive Value, NPV = negative Predictive Value, PR = Prevalence

Table 6 Contingency Table to Determine Diagnostic Performance of Ultrasound in Diagnosing Mesenteric Cyst Taking Histopathology as Gold Standard across Gender

Gender	Ultrasound	Histopathology Mesenteric Cyst	No	Total	Diagnostic Performance
Boy (n=54)	Mesenteric Cyst	28	4	32	SN=90.32%, SP=82.61%
	No	3	19	22	PPV=87.50%, NPV=86.37%
	Total	31	23	54	AC=87.04%, PR=57.4%
Girl (n=46)	Mesenteric Cyst	18	3	21	SN=75.0%, SP=86.36%
	No	6	19	25	PPV=85.73%, NPV=75.98%
		24	22	46	AC=80.43%, PR=52.2%

Table 7 Contingency Table to Determine Diagnostic Performance of Ultrasound in Diagnosing Mesenteric Cyst Taking Histopathology as Gold Standard across Cyst Size

Cyst Size	Ultrasound	Histopathology		Total	Diagnostic Performance
		Mesenteric Cyst	No		
1-2 cm (n=67)	Mesenteric Cyst	29	5	34	SN=78.38%, SP=83.33%
	No	8	25	33	PPV=85.28%, NPV=75.75%
	Total	37	30	67	AC=80.60%, PR=55.2%
3 cm (n=33)	Mesenteric Cyst	17	2	19	SN=94.44%, SP=86.67%
	No	1	13	14	PPV=89.46%, NPV=92.87%
		18	15	33	AC=90.91%, PR=54.5%

Table 8 Contingency Table to Determine Diagnostic Performance of Ultrasound in Diagnosing Mesenteric Cyst Taking Histopathology as Gold Standard across Weight

Weight	Ultrasound	Histopathology		Total	Diagnostic Performance
		Mesenteric Cyst	No		
Upto 25 kg (n=49)	Mesenteric Cyst	19	4	23	SN=79.17%, SP=84.0% PPV=82.62%, NPV=80.76% AC=81.63%, PR=49.0%
	No	5	21	26	
	Total	24	25	49	
>25 kg (n=51)	Mesenteric Cyst	27	3	30	SN=87.10%, SP=85.0% PPV=89.70%, NPV=81.45% AC=86.26%, PR=60.0%
	No	4	17	21	
		31	20	51	

DISCUSSION

Mesenteric cysts are rare, fluid-filled lesions that occur within the mesentery, often posing diagnostic challenges due to their varied presentation.[12,13] Histopathology is considered the gold standard for diagnosis; however, it is invasive, time-consuming, and may not always be feasible.[14] With advancements in ultrasound technology, there is growing interest in using it as a non-invasive, accessible diagnostic tool.[15,16] However, existing data on the accuracy of ultrasound in diagnosing mesenteric cysts was scarce.[10,11] To address this gap, this study was planned to evaluate the diagnostic accuracy of ultrasound in diagnosing mesenteric cysts, taking histopathology as the gold standard for comparison.

This study included 100 participants, with a mean age of 8.26±2.75 years. Among them, 34% were aged between 1 and 6 years, while 66% were aged between 7 and 12 years. Previously, Tripthy et al. reported that 65 of the participants were neonates, 19% were infants and 75%.[17] Yashi et al. reported 12.2% study population had age less than 20 years whereas mean age in similar studies was reported as 38.5±6 years and 36.0±6.44 years by Yashi et al. and Hameer et al., respectively.[11,18] This difference in age may be associated with inclusion criteria of each study.

In terms of gender distribution, 54% of the participants were boys and 46% were girls. Likewise, higher propriety of males was reported by Tripathy et al. as 53.0%.[17] The mean cyst size was 1.99 ± 0.82 cm, with 67% of participants having cysts ranging from 1 to 2 cm, and 33% having cysts measuring 3 cm. The mean weight of the participants was 29.06 ± 9.29 kg, with 49% weighing up to 25 kg and 51% weighing more than 25 kg.

In this study, ultrasound detected mesenteric cysts in 53 participants (53.0%), while 47 participants (47.0%) were not diagnosed with a mesenteric cyst using ultrasound. Histopathology, which served as the gold standard for diagnosis, confirmed mesenteric cysts in 55 participants (55.0%), while 45 participants (45.0%) did not have a mesenteric cyst according to

histopathological findings. Prevalence of disease on histopathology reported as 56.2% by Yashi et al. whereas in a similar study on ovarian neoplasm prevalence of disease on histopathology was reported as 82.7% by Hameer et al.[11,18]

Out of 100 participants, ultrasound identified 46 true positives, 7 false positives, 9 false negatives, and 38 true negatives. Sensitivity was 83.64%, specificity 84.44%, accuracy 84.00%, positive predictive value 86.79%, and negative predictive value 80.85%, with disease prevalence at 55%. Our study is a valuable addition in existing body of literature where Mokarabina et al. reported sensitivity 96.3%, specificity 60.0%, PPV 92.86%, NPV 75.0% and diagnostic accuracy 90.62% of ultrasound in diagnosing mesenteric cyst while taking histopathology as gold standard.[10]

In other similar studies involving abdominal cysts, Yashi et al. reported sensitivity 73.7%, specificity 80.3%, PPV 53.8%, NPV 90.7% and diagnostic accuracy 90.62% of ultrasound in diagnosing pelvic masses while taking histopathology as gold standard.[11] Tariq et al. reported sensitivity 65.7%, specificity 50.9%, PPV 71.1%, NPV 44.6% and diagnostic accuracy 60.5% of ultrasound in diagnosing adenomyosis while taking histopathology as gold standard.[19] Hameer et al. reported sensitivity 82.68%, specificity 73.68%, PPV 93.67%, NPV 47.46% and diagnostic accuracy 82.7% of ultrasound in diagnosing ovarian neoplasm while taking histopathology as gold standard.[18] Diagnostic accuracy of ultrasound in diagnosing mesenteric cyst taking histopathology as gold standard has been stratified for age, gender, cysts size and weight wherein all the sub groups, almost similar diagnostic accuracy was observed.

This study's strength lies in evaluating the diagnostic accuracy of ultrasound for mesenteric cysts, providing valuable insights into its reliability compared to histopathology. The non-invasive nature of ultrasound makes it an accessible tool for diagnosis. However, limitations include the relatively small sample size and the lack of diverse populations. Future studies should focus on larger, multicenter trials with a more varied demographic to confirm these findings and further establish ultrasound as a primary diagnostic tool for mesenteric cysts.

CONCLUSION

In conclusion, ultrasound demonstrated high diagnostic accuracy for detecting mesenteric cysts, with a sensitivity of 83.64%, specificity of 84.44%, and overall accuracy of 84.00%. The results indicate that ultrasound is a reliable method for diagnosing mesenteric cysts, with consistent performance across different subgroups based on age, gender, cyst size, and weight. This highlights ultrasound as an effective tool for accurately identifying both the presence and absence of mesenteric cysts.

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