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Study to evaluate mesenteric lymph node on ultrasound and its association with clinical symptoms in pediatric population

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ABSTRACT

Background: Abdominal pain is a frequent complaint in children, often leading to diagnostic uncertainty due to its non-specific presentation and varied etiology. Mesenteric lymphadenopathy is a common yet ambiguous ultrasound finding in such cases. While often benign and reactive, it can also signify infections, inflammatory diseases, or malignancies. Ultrasonography (USG) serves as a first-line modality due to its safety, accessibility, and diagnostic yield in evaluating pediatric abdominal pathology. **Aims and Objective:** The aim of the study was to assess the diagnostic value of USG in detecting enlarged mesenteric lymph nodes (MLNs) and to correlate sonographic findings with clinical symptoms in the pediatric population. **Materials and Methods:** This observational cross-sectional study included 180 pediatric patients (aged neonate to 18 years) presenting with abdominal symptoms at a tertiary care center between February 2020 and September 2021. All subjects underwent grayscale and color Doppler USG. Lymph node characteristics – size, shape, vascularity, echogenicity, and associated abdominal findings – were recorded and analyzed using the Statistical Package for the Social Sciences v21. **Results:** Significantly enlarged MLNs (Short-axis diameter [SAD] ≥5 mm) was found in 100 (55.5%) patients, predominantly in males (72%). Most nodes were located in the right iliac fossa and periumbilical regions. Among them, 60% showed no other abnormal USG findings. However, 40% had additional ultrasound features suggesting specific etiologies, including reactive adenitis (23%), tubercular adenitis (8%), lymphoma (1%), and metastasis (1%). Statistical correlation revealed a significant association between lymph node size and the presence of clinical symptoms ($P<0.05$). Nodes with absent hilum, heterogeneous echotexture, and high resistivity index were more likely to represent pathological conditions. **Conclusion:** Ultrasound is a valuable non-invasive tool for evaluating mesenteric lymphadenopathy in symptomatic children. A SAD ≥5 mm is a useful threshold. Correlation with clinical findings enhances diagnostic accuracy, aids in avoiding unnecessary interventions, and facilitates early identification of serious underlying conditions.

Key words: Mesenteric lymphadenitis; Pediatric abdominal pain; Ultrasonography; Reactive lymphadenopathy; Tubercular adenitis

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INTRODUCTION

Abdominal pain is a common presenting symptom among children in emergency and outpatient settings, often posing a diagnostic challenge due to its non-specific nature and wide differential diagnoses. One of the frequently observed yet clinically ambiguous findings during abdominal ultrasonography (USG) in pediatric patients is

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mesenteric lymph node (MLN) enlargement.[1] The clinical relevance of this finding remains debatable, as mesenteric lymphadenopathy may represent a spectrum of conditions ranging from benign reactive processes to serious infective, inflammatory, or malignant diseases.[2]

USG has emerged as a primary imaging modality in pediatric abdominal evaluation due to its safety profile, cost-effectiveness, and absence of ionizing radiation. It enables high-resolution visualization of lymph node morphology, echogenicity, vascularity, and size. Despite these advantages, a clear diagnostic framework correlating ultrasound findings of MLNs with clinical presentations in children is lacking. This often results in either underestimation of clinically significant lymphadenopathy or over-investigation of benign conditions, leading to unnecessary referrals and parental anxiety.[3]

Mesenteric lymphadenitis, often characterized by clusters of enlarged lymph nodes predominantly in the right lower quadrant (RLQ), is a well-recognized cause of pseudo-appendicular syndrome in children. However, enlarged mesenteric nodes can also be incidental, especially in asymptomatic individuals, or reflect underlying systemic illnesses such as tuberculosis (TB), parasitic infections, human immunodeficiency virus (HIV), or lymphoma. Establishing sonographic thresholds and diagnostic criteria for identifying clinically significant lymphadenopathy remains a subject of ongoing research.[4]

Aims and objectives

Aims

The aim of the study was to evaluate the diagnostic value of USG in detecting MLN enlargement and its clinical correlation in pediatric patients with abdominal symptoms.

Objectives

The objectives of the study are as follows:

- To determine the prevalence and sonographic features of enlarged MLNs (≥5 mm short-axis diameter [SAD]) in children.
- To correlate lymph node size, location, and vascularity with clinical symptoms and final diagnosis.
- To differentiate between reactive, infective, inflammatory, and malignant lymphadenopathy based on ultrasound characteristics.
- To assess diagnostic thresholds and patterns that suggest specific etiologies such as TB, HIV, appendicitis, or malignancy.
- To evaluate outcomes and treatment response based on lymph node size and symptom duration.

MATERIALS AND METHODS

Research design

This observational and cross-sectional study was conducted in the Department of Radiodiagnosis at Maharani Laxmi Bai Medical College, Jhansi, Uttar Pradesh, in collaboration with the Department of Paediatrics. A total of 180 pediatric patients, ranging from neonates to 18 years of age and presenting with abdominal symptoms, were enrolled over a study period extending from February 2020 to September 2021. All subjects underwent grayscale USG and color Doppler evaluation to assess MLNs, using Medison Sono ACE X8 and GE VIVID T8 ultrasound systems.

Inclusion criteria

- Pediatric patients ranging from neonates to 18 years of age.
- Referred from the Department of Paediatrics or other clinical departments with abdominal signs and symptoms.
- Underwent ultrasonographic evaluation, including whole abdomen and high-resolution scanning.
- Informed consent was obtained from parents or legal guardians.

Exclusion criteria

- History of abdominal trauma.
- History of prior abdominal surgery.
- Patients who were critically ill at the time of examination.
- Uncooperative patients during the ultrasound procedure.

Data collection procedure

After obtaining informed consent from parents or guardians, a detailed clinical history including presenting complaints, duration of symptoms, and relevant birth and developmental history was recorded.

Each subject underwent a grayscale USG and color Doppler flow imaging using high-frequency linear transducers (7–12 MHz) on Medison Sono ACE X8 and GE VIVID T8 ultrasound systems. Scanning was performed in transverse and longitudinal planes with graded compression techniques. Parameters such as the size (long and short axis), shape (L/S ratio), echogenicity, architecture, vascularity patterns, and the presence or absence of fatty hilum or necrosis of MLNs were assessed.

Clinical symptoms were categorized and correlated with the ultrasound findings. The presence of associated abdominal pathology (e.g., appendicitis, colitis, parasitic infestation)

was also noted. All data were recorded in a predesigned structured pro forma. Laboratory investigations such as hemogram, erythrocyte sedimentation rate, C-reactive protein, and stool/serology tests were performed when clinically indicated.

Plan for data analysis

Data were entered in Microsoft Excel and analyzed using Statistical Package for the Social Sciences version 21. Descriptive statistics were used for quantitative and categorical variables. The Chi-square test was applied to assess associations between clinical and sonographic findings. A P<0.05 was considered statistically significant.

Ethical considerations

The study was approved by the M.L.B. Medical College Institutional Review Board. Informed consent was obtained from each of the patients fulfilling the inclusion criteria before their enrolment in the study.

RESULTS

The study cohort predominantly consisted of male children (73.9%), with the majority falling within the 5–12 years age group, suggesting a higher prevalence of mesenteric lymphadenopathy in this demographic (Table 1). Of the 180 children assessed, 100 (55.5%) demonstrated significantly enlarged MLNs (SAD ≥5 mm), with the majority in the 5–8 mm range and most observed in the right iliac fossa (RIF) and periumbilical regions. A statistically significant association was noted between lymph node size and age, with enlargement being more common in the 5–12 years group (P=0.038) (Table 2). Among these 100 cases, 60% had isolated lymphadenopathy without other ultrasonographic abnormalities symptomatic without USG findings (SW/OUF), while 40% had additional USG findings suggesting specific etiologies symptomatic with USG finding (SWUF), such as TB or reactive adenitis (Table 3). Further correlation between lymph node size and symptom association revealed significant findings (P=0.001), particularly with larger nodes (>8 mm) being more commonly linked to pathological conditions in symptomatic children (Table 4). Malignant nodes exhibited specific sonographic features including rounded shape (L/S ratio <1.5), hypoechoic texture, absence of echogenic hilum, heterogeneity, conglomeration, and altered Doppler indices (resistive index >0.8 and pulsatility index >1.6), which helped in distinguishing them from benign reactive nodes (Table 5). In terms of clinical outcome, most cases responded to conservative management, with persistent symptoms and larger lymph nodes (>8 mm) in a few cases being eventually diagnosed as TB (Table 6).

Table 1: Demographic profile of selected study group

Age group (Years)	Gender (n=180)			
	Boys (n=133)	Percentage	Girls (n=47)	Percentage
Birth-4 years	30	22.39	8	17.02
5–12 years	70	52.61	18	38.29
13–18 years	33	24.83	21	44.6

Diverse sonographic features of MLNs are seen, including hypoechoic nodes with G1 vascularity, conglomeration, absent hilum, and calcifications, suggestive of reactive or pathological causes like TB or malignancy (Figure 1). Isoechoic nodes with preserved hilum and central vascularity indicate a benign, reactive process in a malnourished child (Figure 2).

DISCUSSION

This prospective observational study was conducted to evaluate MLNs on USG and assess their association with clinical symptoms in the pediatric population. A total of 180 children were included, among whom 133 (73.9%) were male and 47 (26.1%) were female, demonstrating a clear male predominance. This gender distribution is in line with a study by Simanovsky and Hiller,[5] who also reported higher incidences of MLN in boys, attributing this trend to increased exposure to enteric infections and a heightened immune response in males during early childhood.

Table 2: Distribution of visualized mesenteric lymph node according to size and age group (n=120)

Age group (in years)	Total	Group A (>10 mm)	Group B (8–10 mm)	Group C (5–8 mm)	Group D (<5 mm)
Birth-4 years	16	1	1	12	2
5–12 years	79	1	8	60	10
13–18 years	25	1	6	10	8
Patients with significant mesenteric lymph nodes					
>5 mm short-axis diameter	Male (%)		Female (%)	Total	Percentage
	72 (72.00)		28 (28.00)	100	83.33

The Chi-square statistic is 13. 2739. The *P*=038887. The result is significant at *P*<0.05

Table 3: Visualized significant mesenteric lymph nodes in association with the presence/absence of other significant ultrasonography findings

Condition	Types	Total cases (n=100) (%)
Visualized significant mesenteric lymph nodes	Symptomatic with other significant ultrasonography findings	40 (44.44)
	symptomatic without other significant ultrasonography findings	60 (66.66)

Table 4: Correlation of significantly enlarged lymph nodes on the basis of symptoms with/without significant associated USG findings, and size SWUF (n=40) and SW/OUF (n=60)

Age group (Y)	Group	Group A (>10 mm)	Group B (8–10 Mm)	Group C (5–8 mm)
Birth-4	SWUF	1	1	4
	SW/OUF	1	1	7
5–12	SWUF	1	5	14
	SW/OUF	1	9	21
13–18	SWUF	1	4	9
	SW/OUF	1	6	13

The f-ratio value is 10. 94752. The *P*=001171. The result is significant at *P*<0.05. SWUF: Symptomatic with USG finding, SW/OUF: Symptomatic without USG findings, USG: Ultrasonography

The most affected age group in this study was 5–12 years, comprising 88 patients (48.8%), followed by 13–18 years with 54 patients (30%) and 0–4 years with 38 patients (21.2%). These results are consistent with findings by Vayner et al.,[6] who noted a higher prevalence of mesenteric lymphadenopathy in children between 5 and 13 years, suggesting that immune system maturation and environmental exposure during this age range may play a crucial role.

Ultrasound findings revealed that 100 (55.5%) out of 180 children had significantly enlarged MLNs (SAD ≥5 mm). Most lymph nodes were in the RIF and periumbilical regions, which matches with the findings by Wang et al.,[7] who noted that 46.3% of enlarged MLNs were detected in the RLQ in pediatric patients. Most lymph nodes in this study fell within the 5–8 mm SAD group (Group C), seen in 60 cases (60%), followed by Group B (8–10 mm) in 17 patients (17%) and Group A (>10 mm) in 6 patients (6%).

Among the 100 patients with significant MLNs, 40 (40%) showed associated findings on USG (SWUF), while 60 (60%) did not exhibit any additional ultrasound abnormalities (SW/OUF). This high rate of non-specific MLN is supported by Sivit et al.,[8] who emphasized that mesenteric lymphadenopathy in children with abdominal pain often represents a non-specific reactive process.

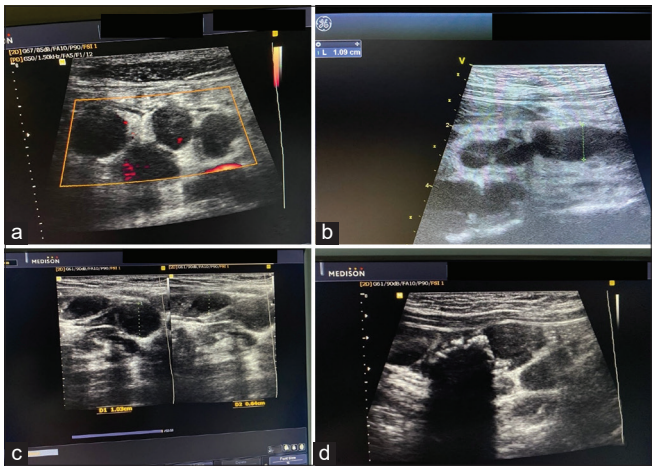

Figure 1: Sonographic Findings in Pediatric Mesenteric Lymphadenopathy (a) Discrete hypoechoic nodes with G1 vascularity in a 6-year-old. (b) Conglomerated lymph node pattern. (c) Absent echogenic hilum. (d) Coarse parenchymal calcifications

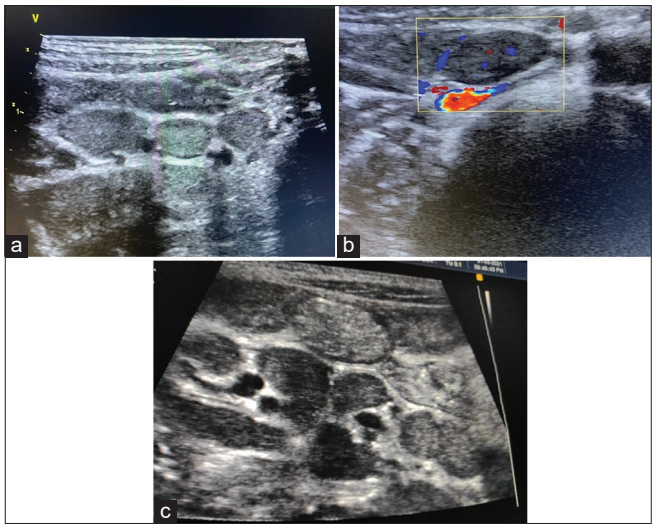

Figure 2: Isoechoic enlarged mesenteric lymph nodes (maximum sad ~9 mm) with maintained fatty hila and central vascularity in severe acute malnutrition

Notably, 60 (66.6%) of the symptomatic children had isolated MLNs without a clear underlying cause, underscoring the importance of clinical correlation to avoid misdiagnosis or overtreatment.

Abdominal pain was the most common clinical complaint, observed in 110 patients (61.1%), followed by vomiting in 88 (48.8%) and fever in 58 (32.2%). This clinical triad is characteristic of mesenteric lymphadenitis, as supported by studies conducted by Balakrishnan et al.,[9] and Sanchez et al.,[10] who reported similar symptom patterns in children with abdominal lymphadenopathy.

Out of the 40 patients with associated USG findings, definite etiological diagnoses were established in 33 cases (82.5%). Among these, tubercular adenitis was the most

Table 5: Sonographic characteristics of malignant lymph nodes in symptomatic patients

Features	Significant USG findings (n=40)					No significant USG findings (n=60)
	Metastasis (n=1) (%)	lymphoma (n=1) (%)	Tuberculosis adenitis (n=8) (%)	Reactive adenitis (n=23) (%)	Symptomatic with USG finding with no definite diagnosis made (n=7) (%)	Non-specific Enlargement (n=60) (%)
Shape L/S ratio						
<1.5 (round)	1 (100)	1 (100)	4 (50)	4 (17)	2 (28)	3 (5)
>2 (oval)	0 (0)	1 (100)	4 (50)	21 (91)	5 (71)	57 (95)
Echogenicity						
Anechoic						
Hypoechoic	1 (100)	1 (100)	5 (63)	5 (21)	0 (0)	2 (3)
Isoechoic	0 (0)	0 (0)	2 (25)	11 (47)	2 (28)	0 (0)
Hyperechoic	0 (0)	0 (0)	3 (37)	0 (0)	0 (0)	0 (0)
Homogenous		1 (100)	6 (75)	20 (86)	6 (85)	52 (86)
Heterogeneous	1 (100)		6 (75)	4 (17)	3 (42)	8 (13)
Hila absent	1 (500)	1 (100)	1 (12.5)	0 (0)	0 (0)	0 (0)
Calcification	0 (0)	0 (0)	3 (37)	0 (0)	0 (0)	0 (0)
Cystic necrosis	1 (100)	0 (0)	2 (25)	0 (0)	0 (0)	0 (0)
Pattern						
Discrete	1 (100)	0 (0)	1 (17)	14 (60)	3 (42)	55 (91)
Conglomerated	0 (0)	1 (100)	7 (87)	7 (30)	1 (14)	6 (10)
Vascularity pattern (CDFI)						
G0	0 (0)	0 (0)	4 (50)	3 (13)	0 (0)	0 (0)
G1	1 (100)	1 (100)	6 (75)	13 (56)	5 (71)	49 (83)
G2	0 (0)	1 (100)	0 (0)	19 (82)	0 (0)	60 (83)
G3	0 (0)	0 (0)	0 (0)	6 (26)	0 (0)	0 (0)
Resistivity index						
<0.8	0 (0)	0 (0)	8 (100)	22 (95)	6 (85)	60 (100)
>0.8	1 (100)	1 (100)	0 (0)	2 (8)	0 (0)	0 (0)
Pulsatility index						
<1.6	0 (0)	0 (0)	8 (100)	21 (91)	6 (85)	60 (100)
>1.6	1 (100)	1 (100)		3 (13)	0 (0)	0 (0)

USG: Ultrasonography, CDFI: Color doppler flow index

Table 6: Distribution of study group according to chronicity and treatment response in relation to site and size of mesenteric lymph node

		Functional abdominal pain							
2 Group	Site of pain	Malignant lymph nodes			Frequency of pain	Duration	Follow up (acute/ chronic)	Treated as	Relieved/ Persistent
		Site	Size (mm)	No. of cases					
Group I (29)	Epigastric+peri-umbilical+RIF	RIF	5–8	15	1/week	1–2 h	2M	Enteritis	Relieved
			>8	4	1/week	1 day	5M	Enteritis	Persistent (DX as TB)
Group II (19)	Periumbilical+RIF	RIF+Periumbilical	5–8	17	2/week	2 day	3M	Enteritis	Relieved
			>8	2	3/week	16–18 h	6M	Enteritis	Persistent (DX as TB)
Group III (4)	Periumbilical+Epigastrium	Periumbilical+RIF+LIF	5–8	3	1/week	16–18 h	3M	Enteritis	Relieved
			>8	1	3/week	1–2 h	2M	Enteritis	Relieved
Group IV (8)	Peri-umbilical+RIF+LIF	RIF+periumbilical	5–8	5	3/week	1–2 h	2M	Enteritis	Relieved
			>8	3	3/week	1 day	3M	Enteritis	Relieved

RIF: Right iliac fossa, LIF: Left iliac fossa, TB: Tuberculosis

frequent, found in 8 patients (24.2%), followed by reactive adenitis in 23 cases (69.7%), lymphoma in one case (3%), and metastatic node in 1 case (3%). Jain et al.,[11] have previously described the utility of sonographic criteria such as conglomerated nodes, central necrosis, and mesenteric thickening in diagnosing abdominal TB. In our study, the presence of hypoechoic, heterogeneous MLNs with absent central hilum and calcification correlated well with TB cases.

Among the SW/OUF group (n=60), the absence of other USG findings despite the presence of enlarged MLNs indicates that many such cases are self-limiting or reactive in nature. This is echoed by Das et al.,[12] and Sivit et al.,[8]

who noted that isolated MLNs, particularly in the absence of specific laboratory or imaging abnormalities, are often benign and respond well to conservative treatment.

Thus, our study reinforces the value of ultrasound as the primary imaging tool for evaluating abdominal symptoms in children. It not only provides detailed morphological characterization of MLNs but also aids in differentiating between reactive, infective, and malignant etiologies. By identifying non-specific MLNs, unnecessary surgical exploration can be avoided. Further large-scale and multicenter studies are recommended to refine diagnostic thresholds and validate the use of SAD ≥5 mm in the Indian pediatric population.

Limitations of the study

This study has certain limitations that should be considered while interpreting the findings. First, the sample size was relatively small, which may limit the generalizability of the results to a wider population. Second, the study was conducted within a limited time frame, restricting the depth of data collection and analysis. Third, the reliance on self-reported information may have introduced bias, as participants' responses could be influenced by memory or personal perceptions. Finally, external factors beyond the control of the researcher, such as environmental and social influences, may also have affected the outcomes. Despite these limitations, the study provides useful insights and a foundation for future research.

CONCLUSION

Enlarged MLNs are a prevalent finding in pediatric patients presenting with abdominal symptoms, particularly pain, and are often associated with self-limiting inflammatory conditions such as mesenteric adenitis. USG proved to be a valuable, non-invasive, and cost-effective modality for early detection and differentiation from surgical conditions like appendicitis, thereby preventing unnecessary interventions. The study highlights that while mesenteric lymphadenopathy is frequently non-specific, correlating clinical presentation with sonographic features aids in narrowing differential diagnoses and guiding further management. Regular follow-up remains essential to identify underlying pathologies like TB or malignancy in persistent cases.

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Recommendations

- Ultrasound should be considered the first-line imaging modality in pediatric patients presenting with abdominal symptoms suggestive of mesenteric lymphadenitis due to its non-invasive nature, absence of radiation, and diagnostic utility.
- Clinicians should interpret MLN enlargement in the context of clinical symptoms and laboratory parameters to avoid unnecessary surgical interventions.
- A SAD ≥5 mm on USG may be used as a practical threshold for identifying significant mesenteric lymphadenopathy in symptomatic children.
- Further longitudinal studies with larger sample sizes and histopathological correlation are recommended to validate the diagnostic criteria and strengthen the specificity of sonographic features.
- Development of standardized reporting formats for MLN evaluation in pediatric ultrasound can aid in early diagnosis and treatment planning.

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AKR, PK, S and **SP-** Definition of intellectual content, Literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article, Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision, design of study, statistical analysis and interpretation, review manuscript, review manuscript, literature survey, coordination and manuscript revision.

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