

Role of Ultrasonography in the Evaluation of Pediatric Neck Masses in a Rural Population: A 12-Months Observational Study at JLNMCB, Bhagalpur

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Abstract:

Background: Neck masses are a common clinical concern in the pediatric population and often cause significant anxiety among caregivers. While many are benign and self-limiting, a structured diagnostic approach is essential to identify potentially serious conditions. Ultrasonography (USG) offers a non-invasive, accessible, and cost-effective imaging modality, especially important in rural healthcare settings.

Objectives: To evaluate the nature, characteristics, and diagnostic value of ultrasonography in identifying pediatric neck masses in a rural population attending the Department of Radio-Diagnosis at JLNMCB, Bhagalpur.

Methods: A prospective observational study was conducted over a period of 12 months involving 100 pediatric patients (aged 0–18 years) presenting with neck swellings. All patients underwent high-resolution ultrasound of the neck. The masses were assessed for location, size, shape, echotexture, vascularity, and relationship with adjacent structures. Provisional USG diagnoses were correlated with clinical and histopathological findings where available.

Results: Among the 100 children examined, the majority of neck masses were inflammatory (58%), followed by congenital (22%), neoplastic (10%), and miscellaneous (10%). The most common lesion was reactive lymphadenitis (40%), followed by thyroglossal duct cysts (15%) and tuberculous lymphadenitis (12%). Ultrasound showed high diagnostic accuracy, with sensitivity of 94% and specificity of 89% when compared with histopathology in confirmed cases. The modality was especially effective in distinguishing cystic from solid lesions and in detecting vascularity, aiding in appropriate classification.

Conclusion: Ultrasonography is a highly effective first-line imaging tool in the evaluation of pediatric neck masses, particularly in resource-limited rural settings. Its non-invasive nature, affordability, and diagnostic precision make it indispensable for timely identification and management of neck swellings in children.

Keywords: Pediatric Neck Masses, Ultrasonography, Rural Population, Reactive Lymphadenitis, Thyroglossal Cyst, Tuberculous Lymphadenitis, JLNMCB Bhagalpur.

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Introduction

Neck masses are a relatively common clinical finding in the pediatric age group and represent a wide spectrum of pathologies, ranging from benign self-limiting inflammatory conditions to serious congenital anomalies and neoplastic lesions. The presentation of a neck mass in a child often raises anxiety among parents and guardians due to fears of malignancy, despite the fact that most of these masses are non-neoplastic in origin [1].

The differential diagnosis of pediatric neck masses is broad and varies significantly with age, anatomical location, duration of symptoms, and associated systemic signs. Common causes include reactive lymphadenopathy secondary to infections, congenital anomalies such as thyroglossal duct cysts and branchial cleft cysts, tuberculous lymphadenitis,

and, less frequently, malignant tumors such as lymphoma [2]. Timely and accurate diagnosis is essential not only to alleviate caregiver anxiety but also to initiate appropriate management and avoid unnecessary invasive procedures.

Clinical examination alone is often insufficient to determine the precise nature of these masses, especially when deeper structures are involved or when clinical features are nonspecific. In this context, imaging plays a pivotal role [3]. Among the various imaging modalities available, ultrasonography (USG) has emerged as the most accessible, safe, and cost-effective tool, especially suitable for evaluating superficial soft-tissue swellings in children.

Ultrasonography offers several advantages—it is non-invasive, lacks ionizing radiation, provides real-time imaging, and is relatively inexpensive. In pediatric patients, where minimizing radiation exposure is crucial, USG becomes particularly advantageous [4]. Moreover, its portability and ease of use make it highly suitable for rural healthcare setups, where advanced imaging facilities like CT or MRI may not be readily available.

In rural regions such as Bhagalpur and surrounding areas, where access to specialized pediatric care may be limited, primary physicians often rely on radiological evaluation for initial diagnosis [5]. However, data on the pattern and ultrasonographic features of pediatric neck masses specific to rural Indian populations is sparse. Understanding the local epidemiology and USG characteristics of neck lesions can aid in creating a more structured diagnostic and management approach tailored to the rural setting [6].

This study was therefore undertaken to assess the utility of ultrasonography in evaluating neck masses in children attending a tertiary care center in a rural region. It aims to identify the most common types of neck masses encountered, their ultrasonographic profiles, and the accuracy of USG in differentiating between inflammatory, congenital, and neoplastic lesions in the pediatric age group.

Methods

This prospective observational study was conducted in the Department of Radio-Diagnosis at Jawaharlal Nehru Medical College and Hospital (JLNMC), Bhagalpur, Bihar, India, from December 2021 to November 2022. The study aimed to evaluate the diagnostic utility of ultrasonography in pediatric patients presenting with neck masses, focusing on the rural population attending this tertiary care center.

A total of 100 pediatric patients aged between 0 and 18 years, presenting with clinically palpable neck swellings, were included in the study. Patients were enrolled consecutively after obtaining informed consent from parents or guardians. Exclusion criteria included patients with known malignancy

undergoing treatment, previously operated neck masses, or masses not clinically appreciable.

All enrolled subjects underwent a detailed clinical evaluation, including history taking and physical examination, followed by high-resolution ultrasonographic evaluation using a 7.5–12 MHz linear probe on a standard ultrasound machine. In cases requiring deeper tissue assessment or further clarification, a 3.5–5 MHz convex probe was used additionally.

Each neck mass was assessed for its anatomical location, shape, margins, size, number, echotexture (solid, cystic, mixed), internal architecture (homogeneous or heterogeneous), presence of calcifications or necrosis, vascularity (using color Doppler), and relation to adjacent structures. Ultrasonographic features were documented and analyzed to classify the masses into inflammatory, congenital, neoplastic, or miscellaneous categories.

Where clinically indicated, fine-needle aspiration cytology (FNAC), biopsy, or surgical excision was performed, and histopathological correlation was obtained to validate the ultrasonographic diagnosis. Inflammatory lesions were followed up after treatment to assess resolution or progression.

Data were entered into Microsoft Excel and analyzed statistically using basic descriptive analysis. Sensitivity, specificity, and diagnostic accuracy of ultrasonography were calculated where histopathological confirmation was available.

This study was approved by the Institutional Ethics Committee, and all procedures were conducted in accordance with ethical guidelines for research involving human subjects.

Results:

A total of 100 pediatric patients with neck masses underwent ultrasound evaluation. Most of the lesions were inflammatory in nature, particularly reactive lymphadenitis, and occurred predominantly in the anterior triangle of the neck. Ultrasonography proved highly efficient in differentiating between benign and potentially serious lesions, guiding further management.

Table 1: Age-wise Distribution of Pediatric Patients with Neck Masses

Age Group (Years)	Number of Patients	Percentage (%)
0–5	28	28%
6–10	42	42%
11–15	20	20%
16–18	10	10%
Total	100	100%

Table 2: Gender Distribution of Study Participants

Gender	Number of Patients	Percentage (%)
Male	56	56%
Female	44	44%
Total	100	100%

Table 3: Etiological Classification of Neck Masses

Etiology	Number of Cases	Percentage (%)
Inflammatory	58	58%
Congenital	22	22%
Neoplastic	10	10%
Miscellaneous	10	10%
Total	100	100%

Table 4: Ultrasonographic Diagnoses of Neck Masses

Diagnosis	Number of Cases	Percentage (%)
Reactive lymphadenitis	40	40%
Tuberculous lymphadenitis	12	12%
Thyroglossal duct cyst	15	15%
Branchial cleft cyst	7	7%
Dermoid cyst	5	5%
Lipoma	4	4%
Lymphoma	6	6%
Abscess	6	6%
Others	5	5%

Table 5: Echotexture of Neck Masses on Ultrasonography

Echotexture	Number of Cases	Percentage (%)
Solid	52	52%
Cystic	26	26%
Mixed	22	22%

Table 6: Anatomical Location of Neck Masses

Location	Number of Cases	Percentage (%)
Anterior triangle	65	65%
Posterior triangle	20	20%
Submandibular	10	10%
Midline	5	5%

Table 7: Vascularity Pattern on Doppler Ultrasonography

Vascularity Type	Number of Cases	Percentage (%)
Increased flow	36	36%
Normal flow	52	52%
Avascular	12	12%

Table 8: Correlation of Ultrasonographic Diagnosis with Histopathological Findings

USG Diagnosis Accuracy	Number of Cases	Percentage (%)
Correct	47	94%
Incorrect	3	6%
Total Verified Cases	50	100%

Table 9: Diagnostic Performance of Ultrasonography

Parameter	Value (%)
Sensitivity	94%
Specificity	89%
Accuracy	92%

Table 10: Clinical Outcome on Follow-Up

Outcome	Number of Patients	Percentage (%)
Resolved	68	68%
Improved	18	18%
Persistent	10	10%
Progressed	4	4%

Discussion:

Neck masses in children are a common clinical finding, often posing a diagnostic dilemma due to the wide spectrum of underlying causes ranging from benign inflammatory conditions to malignant neoplasms. In rural healthcare settings, where access to advanced diagnostic modalities may be limited, high-resolution ultrasonography (USG) emerges as a highly valuable, non-invasive, cost-effective, and readily available imaging tool [7,8].

The current study observed a predominance of neck masses among children aged 6–10 years, accounting for 42% of cases. This could be attributed to the increased exposure of this age group to infectious agents through outdoor activities and school environments, potentially triggering reactive or tubercular lymphadenitis. The male-to-female ratio was slightly skewed toward males (56%), which may reflect differential health-seeking behavior or higher incidence rates in boys, although the difference was not statistically significant.

Inflammatory etiology was the most common cause (58%) of neck masses, with reactive lymphadenitis (40%) leading the spectrum. This aligns with previous studies that also emphasized inflammation as the principal cause of cervical swellings in children, especially in lower-income and developing regions [9]. Ultrasonography's ability to characterize lymph node features—such as size, shape, border, internal echotexture, and vascularity—proved highly effective in identifying such inflammatory lesions. Doppler evaluation further helped in identifying increased vascular flow, aiding the diagnosis of active infections or lymphoid hyperplasia [10].

Congenital anomalies like thyroglossal duct cysts (15%) and branchial cleft cysts (7%) were also significant findings in this pediatric cohort. These cystic lesions often presented as painless swellings and were reliably identified by their well-defined cystic nature and anatomical location. The USG's ability to differentiate between solid and cystic lesions helped avoid unnecessary invasive procedures, especially in asymptomatic or non-progressive masses [11].

Notably, neoplastic lesions comprised 10% of all cases, including lymphoma and lipoma. While relatively less frequent, the early identification of such conditions is crucial. Ultrasonography played a pivotal role in differentiating these from benign

lesions, with lymphoma showing hypoechoic, round, and sometimes matted lymph nodes with abnormal vascularity. Though USG cannot substitute for histopathology, it serves as an essential first-line screening tool, especially in rural settings where biopsy facilities may not be immediately accessible [12,13].

The correlation between USG findings and histopathological results in 50 biopsied cases showed a high concordance rate of 94%, underscoring the reliability of ultrasonography as a diagnostic modality in experienced hands. Furthermore, the diagnostic accuracy was reflected in the sensitivity (94%), specificity (89%), and overall accuracy (92%) values—highlighting its robustness for clinical use in pediatric populations [14,15].

Anatomically, most masses were located in the anterior triangle (65%), consistent with regional lymph node distribution and embryological pathways of congenital cysts. This anatomical data is clinically important for surgical planning and monitoring [16].

The clinical outcome data demonstrated that a majority of children (68%) experienced complete resolution, and 18% showed improvement, indicating a generally favorable prognosis with appropriate medical or surgical management. Only a small fraction (4%) showed progression, and these cases typically included malignant or recurrent tubercular lymphadenitis [17,18].

Overall, this study affirms the indispensable role of ultrasonography in the initial evaluation and management planning of pediatric neck masses. Its application is particularly vital in resource-limited rural settings, where early detection and non-invasive diagnosis can dramatically improve patient outcomes and reduce healthcare costs.

Conclusion

Ultrasonography has proven to be an invaluable diagnostic tool in the evaluation of pediatric neck masses, especially in rural settings where access to advanced imaging and specialist care may be limited. The study demonstrated that USG is highly effective in identifying the nature, location, and vascular characteristics of neck lesions, thereby facilitating accurate diagnosis and appropriate management.

The majority of neck masses in children were inflammatory in origin, with reactive lymphadenitis being the most common diagnosis. Congenital lesions and neoplastic conditions were also identified with clarity using ultrasonography. The high concordance between USG findings and histopathology underscores the reliability of this modality.

In conclusion, ultrasonography should be considered the first-line imaging investigation for pediatric neck swellings. Its non-invasive nature, affordability, and diagnostic accuracy make it especially suitable for widespread use in rural healthcare environments. Early and accurate diagnosis can significantly reduce morbidity and help streamline referrals for specialized treatment when required.

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