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AN IN-DEPTH CLINICAL AND PATHOLOGICAL ANALYSIS OF NECK MASSES IN THE PAEDIATRIC AGE GROUP

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Abstract
Non-infective Paediatric neck masses constitute a wide array of conditions, ranging from benign congenital anomalies to malignancy. Early and correct diagnosis is crucial to avoid complications & delayed interventions. This 30-month prospective observational study was undertaken among 42 paediatric patients with neck swellings presenting to a tertiary care centre. Each patient was subjected to careful clinical evaluation, imaging such as ultrasonography (USG), computed tomography (CT), and magnetic resonance imaging (MRI) as indicated, and fine needle aspiration cytology (FNAC). Histopathological examination was done in cases as required for confirmation of diagnosis. The patients were followed up at two, six, and twelve months for assessment of results and recurrence. The estimated incidence of Non-infective paediatric neck masses was one in 1,553 paediatric ENT cases. The most common were congenital lesions, representing 59.5 percent of the cases, with the most common being lymphangiomas. Malignancies represented 23.8 percent, which were mostly non-Hodgkin lymphoma. FNAC was 96.2 percent sensitive and 79.4 percent concordant with histopathology. Surgical intervention was the most frequent treatment modality, applied to 57 percent of cases, followed by chemotherapy and medical therapy. Two recurrences were reported in lymphangiomas, and minor complications occurred in both the surgery and chemotherapy groups. A combination of clinical, radiological, and cytological findings based on anatomy can enhance early diagnosis and targeted treatment of paediatric masses of the neck. Location of the lesion is a useful malignancy predictor. Multicentre studies with uniform diagnostic protocols and longer follow-up are necessary to confirm these observations.

Keywords: Clinicopathological correlation; Congenital neck lesions; Fine needle aspiration cytology; Lymphangioma; Non-infective Paediatric neck masses

Introduction

Commonest paediatric neck swellings seen in clinical practice like lymphadenitis are of infective origin & usually subside with the conservative management. There are many possible causes for a non-infective neck swelling in children, including thyroglossal duct cysts, branchial cleft anomalies, dermoid cysts, vascular malformations, and lymphomas. [4] Identifying these swellings as soon as possible is necessary to prevent disfigurement, recurrence, or missing a malignancy. [5] About 11% of

neck swellings in children are due to cancer, which makes it important to evaluate them accurately and promptly.

The "Rule of 7" is a useful way to assess a mass in the early stages, suggesting that a mass lasting 7 days is likely inflammatory, 7 months could be neoplastic, and 7 years is usually congenital. A good knowledge of embryology is necessary, especially the development of the pharyngeal apparatus during the fifth to tenth weeks of gestation, since many congenital lesions are due to incomplete regression or maldevelopment of pharyngeal arches, clefts, and pouches. [8] As a result, branchial cleft cysts, thyroglossal duct cysts, and lymphangiomas may develop. [9] Understanding these developmental pathways helps with both diagnosis and planning surgery. Lymphomas are the most common cancer in children, and non-Hodgkin lymphoma is most often seen in early childhood.

Accurate diagnosis relies on clinicopathological correlation. Typically, ultrasonography is used first because it is safe, easy to access, and affordable, but it has limited ability to distinguish certain lesions. Even so, the gold standard for diagnosis is still histopathology, mainly for cases where FNAC results are not clear. This study aims to analyse the clinical, radiological, and pathological features of neck masses in children, focusing on how the site of the mass can predict the cause to help early diagnosis, treatment, and modify surgical plan if surgery is required.

Objectives

The specific objectives of this study are:

1. To determine the incidence and underlying aetiologies of non-infective paediatric neck masses in a tertiary care setting.
2. To perform a comprehensive clinical, radiological, and cytological evaluation and correlate preliminary findings with final histopathological diagnoses.
3. To assess management strategies employed for non-infective paediatric neck masses and analyse treatment outcomes.

By fulfilling these objectives, this study aims to enhance diagnostic precision and guide evidence-based management of paediatric neck masses, ultimately contributing to improved patient outcomes in this vulnerable population.

Review of literature

Non-infective paediatric neck masses may be of different types, including congenital, inflammatory, or neoplastic, and it is crucial to identify them correctly to avoid misdiagnosis or delayed care. Most non-infectious paediatric neck masses are thyroglossal duct cysts, branchial cleft cysts, dermoids, and lymphangiomas. Their symptoms usually fit with the embryological pathways, which helps to identify where they are located. Inflammatory masses, such as reactive and bacterial lymphadenitis, are common and usually don't require extra tests, so they were not included in this study.

Historical studies have shown that congenital lesions are the most common cause of neck masses in children seen in surgical settings, and the rate of malignancy varies.[22] However, many reports from the past are limited by small sample sizes, lack of advanced imaging, and inconsistent diagnostic criteria, so they are not very useful in today's clinical practice.[23] The accuracy of diagnoses in earlier studies was low, as correct identification before surgery was achieved in less than two-thirds of cases\

Ultrasonography is the first choice for imaging neck swellings in children, since it is non-invasive, cost-effective, and can distinguish cystic from solid structures. Besides, ultrasound makes it possible to perform image-guided fine needle aspiration cytology (FNAC), which increases the chances of getting an accurate diagnosis. FNAC is commonly used as the first diagnostic method, offering high accuracy in distinguishing benign from malignant tumours. When done by skilled clinicians and checked with radiology, FNAC can be correct in more than 85% of cases in many paediatric studies. Still, there are some limitations, so histopathology is sometimes needed to confirm the diagnosis.

MRI and contrast-enhanced CT are very useful for examining deep, uncertain, or vascular lesions. MRI is very useful for seeing soft tissues and assessing lymphatic or vascular malformations before surgery. Despite new ways to diagnose neck masses, many types of neck masses still have similar symptoms and images. For this reason, a well-structured approach using clinical examination, imaging, and

cytology is necessary. This study adds to the limited research from South Asian hospitals, looking at how accurately neck masses are diagnosed and how they are managed, and aims to help doctors make better decisions for children in the region.

Materials and Methods

Study Design and Setting

For 30 months, from June 2005 to November 2007, this observational case series was carried out in the Department of Otorhinolaryngology at Government Medical College and Hospital in Nagpur. The purpose of the study was to examine the features of neck masses in children, both clinically, radiologically, and pathologically, and to see how they were treated in a tertiary care hospital.

Study Population

During the study, 42 children with neck swellings were included in the study. The study used 0 to 12 years as the definition of paediatric age, which matches the classification used by the institution. Patients were enrolled from both the outpatient and inpatient departments, as well as from other surgical specialties that needed further evaluation.

Inclusion and Exclusion Criteria

Only children with neck masses that were not caused by infection were considered. They consisted of congenital abnormalities, benign tumours, and possible malignancies. Patients with neck masses that were infected, such as cervical lymphadenitis, abscesses, or tubercular swellings, were not included in the study to concentrate on lesions that needed careful study.

Clinical Evaluation and Data Collection

Each enrolled patient underwent a detailed clinical assessment. The case proforma was used to record data, which included the patient's age, gender, main symptoms, how long the symptoms lasted, other related features (such as fever and difficulty swallowing), and their past and family medical history. After the general and systemic exams, a focused examination of the ears, nose, and throat was done to assess the neck lesion.

Diagnostic Workup

All patients underwent baseline haematological and urinary investigations. All cases began with a high-resolution ultrasound (USG) of the neck, which gave details about the size, consistency, and structure of the lesion. If the lesions were located deep inside, were complex, or spread outside the usual anatomical boundaries, contrast-enhanced CT or MRI was used to fully describe their location. Conventional angiography was only done when vascular malformations were suspected.

All lesions that could be accessed clinically and radiologically were examined by Fine Needle Aspiration Cytology (FNAC). Ultrasound-guided FNAC was utilized where appropriate. In some cases, sedation was given to help the patient cooperate and obtain precise sample. If the cytology was not clear or a histological diagnosis was needed, an incisional or excisional biopsy was done under suitable anaesthesia. If needed, histopathological analysis with special staining and immunohistochemistry was done to confirm the final diagnosis.

Treatment and Follow-Up

The management approach was chosen according to the confirmed diagnosis, the patient's anatomy, and their overall health. Most congenital and benign masses were removed by surgical excision. Chemotherapy was used to treat malignant lesions, and radiotherapy was given in some cases based on the type of cancer and its stage. Patients with lymphocytic thyroiditis or congenital hypothyroidism were started on thyroxine supplementation. Those with vascular anomalies or no symptoms were closely watched without any specific treatment.

All patients were planned to come back for follow-up after 2 months, 6 months, and 1 year. During the follow-up, information on the patient's progress, any recurrence, and side effects from treatment was gathered. No losses were reported during the entire study period.

Statistical Analysis

All the data were gathered and examined using Microsoft Excel 2010. To summarize the demographic information, clinical characteristics, and outcomes of treatment, means, ranges, frequencies, and percentages were used. Standard formulas were used to calculate the sensitivity and specificity of FNAC. Since the study was observational and exploratory, no inferential statistical tests were needed.

Ethical Considerations

Participants in this study were humans, and the study was carried out following the ethical rules in the Declaration of Helsinki. The Institutional Ethics Committee of Government Medical College and Hospital, Nagpur, approved the study under reference number GMCN/IEC/2005/ENT-PED/034.

All parents or legal guardians of paediatric participants gave written consent after they were thoroughly informed about the study's goals, methods, and possible risks. No personally identifiable information was ever collected, disclosed, or published during the study, and patient confidentiality was always respected. No animal subjects were involved in this research.

Results

Demographic Distribution

The study included 42 paediatric patients with neck masses, and it was carried out over a period of 30 months. The patients' ages varied from 45 days to 12 years, and the average age was 7.36 years. The age range 10–12 years had the most cases (30.9%), and this group also had the highest number of malignancies and lymphocytic thyroiditis. The research showed that males outnumbered females (M: F = 1.8:1), with 27 males (64.2%) and 15 females (35.8%). The highest number of non-infective paediatric neck masses was found in children aged 10 to 12 years (30.9%), and the second highest was in children aged 0 to 3 years (28.5%), suggesting that these ages have the most cases.

Table 1: Age Distribution of Paediatric Neck Masses

Age Group (Years)	Number of Cases	Percentage (%)
0–3	12	28.5%
4–6	7	16.7%
7–9	10	23.8%
10–12	13	30.9%

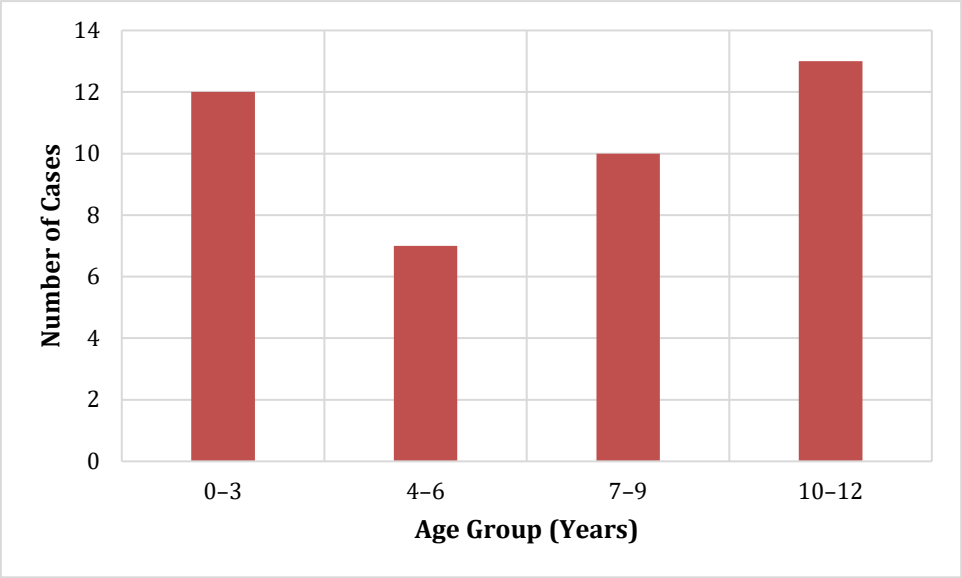

Figure 1: Age Distribution of Paediatric Neck Masses

Figure 1 indicates that the most cases of non-infective paediatric neck masses occurred in children aged 10–12 (13 cases), and the second highest number was in children aged 0–3 (12 cases), which suggests a pattern with peaks for congenital and neoplastic presentations.

Etiological Patterns and Histological Types

Masses in the neck were grouped as congenital, malignant, inflammatory, and benign neoplastic. Most cases were congenital lesions (59.5%), and malignant tumours were the second most common (23.8%). Lymphangioma was the most common congenital lesion, and Non-Hodgkin's lymphoma was found most often in malignancies. The data in Table 2 indicate that most non-infective paediatric neck masses are congenital lesions (59.5%), and the second most common type is malignant tumours (23.8%), meaning that developmental problems and lymphoproliferative disorders are the main causes in this group.

Table 2: Etiological Distribution of Paediatric Neck Masses

Etiology	Number of Cases	Percentage (%)
Congenital	25	59.5%
Malignant	10	23.8%
Inflammatory	4	9.5%
Benign Neoplastic	3	7.14%

Histopathological diagnosis was obtained in 29 cases. Lymphangioma was the most frequently seen lesion (27.5%), followed by thyroglossal cysts (10.3%) and epidermal cysts (10.4%). FNAC had a sensitivity of 96.2% and a specificity of 66.6%, which makes it a useful first-line test.

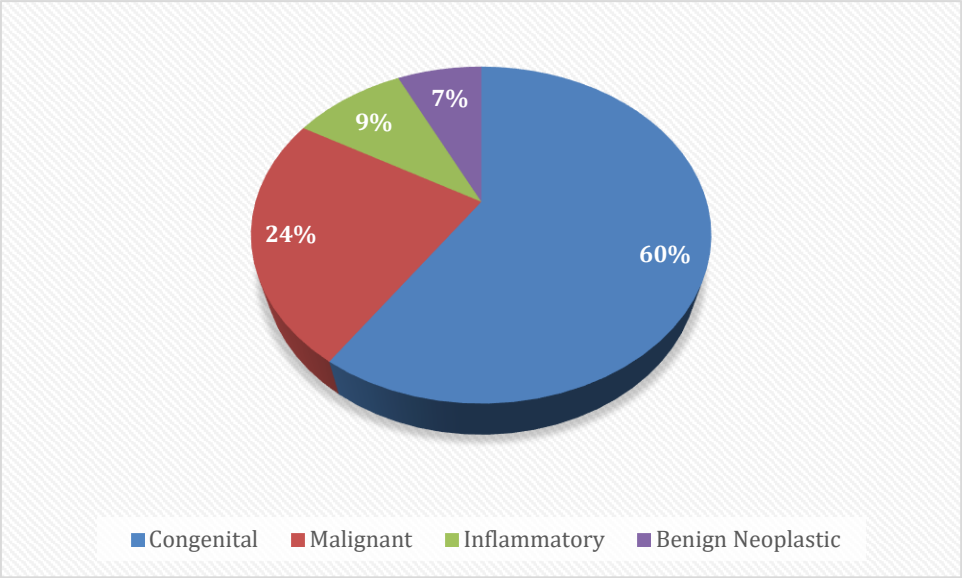

Figure 2: Etiological Distribution of Paediatric Neck Masses

Figure 2 shows how neck masses were divided among 42 paediatric patients. Most of the cases (59.5%) were caused by congenital lesions, while malignant, inflammatory, and benign neoplastic causes made up 23.8%, 9.5%, and 7.1%, respectively, showing that developmental anomalies are most common in children.

Clinical Presentation and Symptomatology

The most common sign was neck swelling, found in 95.5% of patients. Other symptoms were pain (38.1%), fever (23.8%), and loss of appetite (11.9%). Fistula formation and difficulty breathing were each seen in about 2.4% of all cases.

Diagnostic and Radiological Evaluation

All patients had an ultrasound (USG), and it was found to be 78.5% accurate, while CT scan and MRI were 85.7% and 100% accurate, respectively. FNAC was very successful, matching histopathology in 79.4% of the cases.

Treatment Modalities and Outcomes

The majority of the 42 patients, 57%, had surgery, mainly because of congenital lesions. Chemotherapy was used in 21.4%, particularly for lymphomas. A few cases (2.3%) received combined chemo-radiotherapy. In 11.9% of cases, thyroxine therapy was given, and 7.14% of patients were simply observed. The data in Table 3 indicate that most cases were treated surgically (57%), mainly for congenital and benign tumours, whereas chemotherapy and medical therapy were used most often for malignant and endocrine-related lesions.

Table 3: Treatment Modalities for Paediatric Neck Masses

Modality	Number of Cases	Percentage (%)
Surgery	24	57.0%
Chemotherapy	9	21.4%
Chemo + Radiotherapy	1	2.3%
Medical (Thyroxine)	5	11.9%
Observation	3	7.14%

Most of the patients had good results, and 22 of them achieved full resolution. Still, 2 patients had their lymphangiomas return, both in children with lymphangiomas in the floor of the mouth, which is known to be a difficult area to operate on and has a higher chance of recurrence. Three patients had minor

complications after surgery, such as temporary facial nerve weakness (n=1) and thick scarring (n=2). 2 patients who were treated with chemotherapy reported transient anaemia and mucositis. No procedure-related mortality occurred in the study cohort. Table 4 outlines the post-treatment issues and recurrences found in this group, which show the difficulties linked to treating extensive lymphangiomas and using systemic chemotherapy.

Table 4: Post-treatment Complications and Recurrences

Type of Complication	Number of Cases	Treatment Modality
Facial nerve paresis (transient)	1	Surgery
Hypertrophic scar	2	Surgery
Anaemia	1	Chemotherapy
Mucositis	1	Chemotherapy
Recurrence (Lymphangioma)	2	Surgery

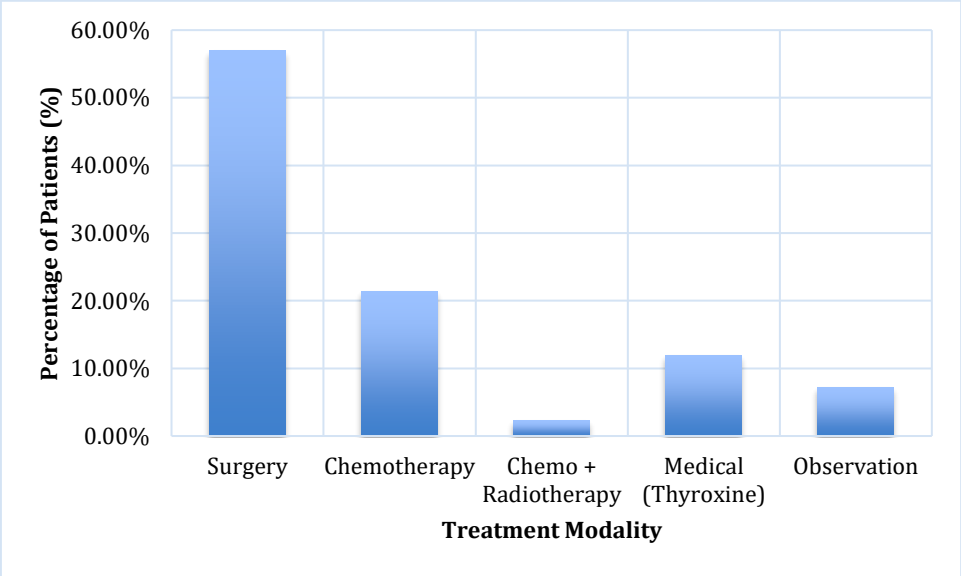

Figure 3: Treatment Modalities for Paediatric Neck Masses

The majority of paediatric neck mass cases were treated with surgery (57%), while chemotherapy was used in 21.4% of cases. Only a small number of patients were treated with thyroxine (11.9%), observation (7.14%), or combined chemoradiotherapy (2.3%), which shows that the main causes of their illnesses were congenital and neoplastic.

Discussion

The study shows that non-infective paediatric neck masses are most commonly caused by congenital lesions, seen in 59.5% of cases. Lymphangioma was found most often, especially in children under three years old, which is in line with its embryological development. [31] The age distribution showed a bimodal pattern, with peaks in the 0–3 and 10–12 age groups. Congenital anomalies were predominant in early childhood, while malignancies and thyroid disorders like lymphocytic thyroiditis were more common in older children. A male predominance (M: F = 1.8:1) was observed, consistent with earlier reports indicating higher rates of congenital and lymphoproliferative disorders among males. [32] Most neck masses were painless, solitary, and located in the anterior triangle. However, firm, multiple swellings in the posterior triangle were more likely to be malignant, particularly lymphomas, emphasizing the diagnostic significance of anatomical site and consistency. [33]

Fine needle aspiration cytology (FNAC) demonstrated high sensitivity and moderate specificity. While helpful in initial diagnosis, its limitations in cystic or mixed lesions highlight the importance of histological confirmation. Inadequate sampling, lesion type, and observer experience are known factors that can reduce FNAC accuracy. [34] Thus, FNAC is best applied as part of a multimodal diagnostic

approach. Ultrasonography was used in all cases and proved effective as a first-line tool, though it has known limitations in evaluating deep or infiltrative lesions. [35] CT and MRI, used selectively, demonstrated high diagnostic accuracies, consistent with literature that supports the superiority of advanced imaging for solid or complex lesions. [36] MRI's ability to visualize soft tissues makes it especially valuable in surgical planning for vascular and lymphatic malformations. [37]

Histopathological evaluation identified lymphangiomas, thyroglossal duct cysts, and epidermal cysts as the most common benign lesions. Non-Hodgkin's lymphoma was the leading malignancy, typically affecting older children and involving the posterior triangle. A 23.8% malignancy rate was observed, similar to rates in studies excluding infectious aetiologies, though some Indian cohorts report lower figures, possibly due to differences in referral or inclusion criteria.[38] Surgical excision was the most frequent treatment modality, leading to high rates of complete remission.[11] Two cases of recurrence in floor-of-mouth lymphangiomas suggest the challenges of operating in anatomically complex regions, where staged or image-guided approaches may be beneficial.[23] Chemotherapy was administered primarily for lymphoma, with complete or partial responses and minimal complications, such as anaemia and mucositis.[4] Minor surgical complications included scarring and temporary nerve weakness. These underscore the importance of postoperative surveillance in sensitive areas.[18] Medical managements with thyroxine was effective for thyroiditis, and observation was appropriate in stable, non-progressive cases.[2] Infants with lymphangiomas in complex locations had higher recurrence risks, reinforcing the need for close follow-up and potential multimodal strategies.[31]

This study supports key clinical principles. Lesion location, presentation, and consistency should guide initial suspicion. FNAC is valuable but must be interpreted in a clinical and radiological context. Ultrasonography remains a reliable first-line imaging modality but may require supplementation with CT or MRI. Surgical excision is curative for most congenital and benign lesions, while infiltrative or recurrent cases demand tailored approaches. [39,40] Several limitations must be noted. The single-centre design and small sample size (n=42) restrict generalizability. The absence of formal statistical tests (e.g., chi-square, regression) limits the strength of inferences. Operator-dependent variability in imaging and cytology may have influenced results, and histopathology was not performed in medically or conservatively managed cases. A 12-month follow-up may not capture long-term complications or late recurrences.

Further studies involving larger, multicentre cohorts are needed to define regional trends. Molecular diagnostics and immunohistochemistry can enhance the characterization of malignancies such as lymphoma and thyroid tumors.[41] Advanced imaging techniques, including diffusion-weighted MRI and AI-assisted interpretation, could improve diagnostic precision in ambiguous cases.[42] Developing algorithms that integrate clinical, radiologic, and cytologic findings may streamline management, especially in resource-limited settings. Long-term follow-up studies assessing recurrence, function, and cosmetic or psychological outcomes will be crucial in optimizing paediatric care.

Conclusion

Non-infective Paediatric neck masses, also rare in the everyday clinic, are a wide array of pathologies that usually make diagnosis difficult. In this 42-patient prospective series collected over 30 months, the incidence was estimated at 1 in 1553.6 paediatric ENT cases. Congenital lesions were most common, with lymphangiomas being the most frequent, especially in children under the age of three. Malignancies were responsible for 23.8% of cases, highlighting the need for early suspicion, particularly for firm, multiple, painless posterior triangle swellings. Clinical correlation with body area, FNAC, and ultrasonography showed almost 80% concordance with histopathology. Determination of lesion location as a malignancy predictor presents a useful diagnostic tool to direct early biopsy and imaging. These results could inform the creation of simplified, location-based triage instruments in ambulatory paediatric ENT practice to direct high-risk cases for emergent imaging and biopsy. The study also offers region-specific epidemiological information from a tertiary Indian institution, filling a void in paediatric ENT literature. Notably, the recurrence seen in lymphangiomas underscores the importance of vigilant postoperative follow-up and anticipatory counselling about long-term results. Although the stepwise, anatomy-guided method appeared to decrease diagnostic delay and

interventions, a single-centre design, limited sample size, and lack of statistical modelling prevent generalizability. The prospective design and clinico-radiological-pathological correlation, however, enhance its internal validity. Multicentre studies in the future are indicated to confirm these observations and facilitate regionally customized clinical guidelines.

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