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Radiological and Clinical Approach to Pediatric Non-Inflammatory Head and Neck Masses

Çocuklarda Enflamatuvar Olmayan Baş-Boyun Kitlelerine Radyolojik ve Klinik Yaklaşım

ABSTRACT

Objective:

Head and neck masses in childhood have a wide variety of causes. These masses may be of congenital, inflammatory, or neoplastic origin. The purpose of imaging is to minimize radiation exposure while obtaining an effective diagnosis or differential diagnosis. Therefore, the first screening study preferred after physical examination is Ultrasonography (US). This study aims to draw attention to the radiological diversity and treatment options in patients presenting with a neck mass, regardless of age.

Material and Methods:

This retrospective study was conducted with pediatric patients who presented with a head-neck mass and underwent radiological imaging between 2018 and 2022. Inflammatory masses, lymphadenopathies, and malignant neoplasms were excluded. Demographic data, radiological diagnostic methods, radiological characteristics of the mass, treatment methods, and pathology results of the patients with congenital and acquired masses were obtained from the hospital system. The lesions of the patients were examined radiologically in 3 groups as cystic, solid, and mixed type.

Results:

The age and gender distribution of 64 patients was similar between the groups. Cystic masses were most commonly congenital, while solid masses were acquired. Head and neck masses were mostly located in the anterolateral cervical triangle. Thyroglossal duct cysts were the most common cystic masses and were mostly of mixed character. The second most common veno-lymphatic malformations (VLM) which constituted the second most common mass were mostly of cystic character. Hemangiomas were the most common solid masses. Among the patients who underwent imaging, 32 (50%) patients were treated surgically. Sclerotherapy was applied to 10 (15.6%) patients at least once. A non-selective beta-blocker drug was administered as medical treatment in 10 (15.6%) patients.

Conclusion:

The etiology of childhood head and neck masses is quite diverse. For this reason, adopting a multidisciplinary approach is extremely important in terms of making the diagnosis correctly and guiding the clinician in choosing the appropriate medical and/or surgical treatment.

Key Words:

Head and neck masses in children, Radiology, Ultrasonography

ÖZ

Amaç:

Çocukluk çağındaki baş boyun kitlelerinin çok çeşitli nedenleri vardır. Bu kitleler konjenital, inflamatuar ve neoplastik kaynaklı olabilirler. Görüntülemenin amacı, etkili bir tanı veya ayırıcı tanı elde ederken radyasyon maruziyetini en aza indirmektir. Bu sebeple fizik muayene sonrasında tercih edilen ilk tarama çalışması ultrasonografidir (USG). Bu çalışma, boyunda kitle nedeniyle başvuran hastalarda radyolojik çeşitliliğine ve tedavi seçeneklerine dikkat çekmeyi amaçlamaktadır.

Gereç ve Yöntemler:

Bu çalışma için 2018-2022 yılları arasında baş-boyun kitlesi ile başvuran ve radyolojik görüntülemesi yapılan çocuk hastaların kayıtlarına ulaşıldı. Enflamatuvar kitleler, lenfadenopatiler ve malign kitleler dışlandı. Doğuştan ve edinilmiş kitlesi olan hastaların demografik verileri, radyolojik tanı yöntemleri, lezyonların lokalizasyonları ile birlikte karekterizasyonları, tedavi yöntemleri ve patoloji sonuçları hastane sisteminden elde edildi. Hastaların lezyonları radyolojik olarak kistik, solid ve mikst tip olmak üzere 3 grupta incelendi.

Bulgular:

Altmış dört hastanın yaş ve cinsiyet dağılımı gruplar arasında benzerdi. Kistik kitleler en sık konjenital iken solid kitleler edinsel nedenliydi. Baş-boyun kitleleri en çok anterolateral servikal üçgende yer almaktaydı. Tiroglossal kanal kistleri en sık rastlanılan kistik kitleler olup daha çok mikst karekterdeydi. İkinci sıklıkla izlenen venolenfatik malformasyonlar (VLM) ise daha çok kistik karekterde görüldü. Hemanjiyonlar ise en sık rastlanılan solid kitlelerdi.

Görüntüleme yapılan hastaların 32'si (%50) cerrahi olarak tedavi edildi. Hastalardan 10'una (%15,6) en az bir kez skleroterapi uygulandı. Medikal tedavi 10 (%15,6) hastada selektif olmayan beta bloker ilaç uygulaması şeklindeydi.

Sonuç:

Çocukluk çağı baş boyun kitlelerinin etiyolojisi oldukça geniş spektrumludur. Bu nedenle tanının doğru konulabilmesi ve uygun medikal ve/veya cerrahi tedavi seçiminde klinisyene rehberlik etmesi açısından multidisipliner bir yaklaşımın benimsenmesi son derece önemlidir.

Anahtar Kelimeler:

Çocuklarda baş ve boyun kitleleri, Radyoloji, Ultrasonografi

INTRODUCTION

Superficial palpable masses of the head and neck are extremely common in the pediatric population, with most of these lesions being benign (1). Head and neck masses in children are divided into four groups as congenital, inflammatory, vascular, and neoplastic. While congenital lesions are more common, lymphadenopathies due to inflammatory masses are the most frequently encountered acquired neck masses (2).

Although the differential diagnosis is often narrowed down by history and physical examination, imaging is required in pediatric neck masses that do not respond to treatment and require surgical resection (3). Imaging techniques such as grayscale and Doppler ultrasonography, computed tomography (CT), magnetic resonance (MR) imaging, and MR angiography can be used to evaluate head and neck masses in children, and all of these methods have advantages and disadvantages (4). Also, imaging aims to achieve an effective diagnosis or differential diagnosis while minimizing radiation exposure (2). For this reason, ultrasonography is the first-line imaging method in the diagnosis and treatment planning of neck mass. In most cases, sufficient information can be obtained by the US (3).

The study aimed to evaluate the clinical and radiological features of neck masses in children and how they might help in diagnosis.

MATERIAL and METHODS

This retrospective study was approved by the ''Ethical Committee of the Faculty of Medicine, S.B Istanbul Medeniyet University Göztepe Training and Research Hospital" with the ethics committee approval number 2022/0555, in compliance with the Helsinki Declaration. The patients, who were referred to the Pediatric or Pediatric Surgery clinics with a mass in the head and neck between January 2018 and January 2022 and who underwent imaging, were evaluated retrospectively.

Inclusion criteria were as follows 1- unilateral or bilateral neck masses; 2- age < 18 years. Patients with inflammatory masses and malignant neoplasms were excluded. Demographic data, radiological diagnostic methods, radiological characteristics of the mass, treatment methods, and pathology results of the patients with congenital and neoplastic masses were obtained from the hospital system. USG was performed by a single radiologist who had more than 10 years of pediatric radiology experience. The images were evaluated retrospectively by the same radiologist via the Picture Archiving Communication Systems (PACS). These congenital (C) and acquired (A) masses of the patients were examined radiologically in 3 groups as cystic, solid, and mixed type. In addition, the lesions were divided into 7 regions according to their anatomic location as calvarial, facial, parotitis, anterolateral, posterior, and multi-compartment. Based on the definite diagnosis, each patient underwent the appropriate medical and/or surgical treatment. The non-surgical group was classified as sclerotherapy, medical, and follow-up.

Statistical Analysis

Statistical analyses were performed using SPSS 21.0, Chicago, IL, USA. Normality testing was performed with the Kolmogorov–Smirnov test. Normal distributions were evaluated with the Student's T test and non-normal distributions were evaluated with the one-way ANOVA test. Data for the continuous variables were given as mean standard deviation. A value of $p<0.05$ was considered significant.

RESULTS

Between 2018 and 2022, 64 children (32 boys, 32 girls) who had neck masses were admitted to the hospital because of diagnostic/prognostic difficulties and/or for treatment. The mean age of the patients was 83±64 months. The primary

complaint of all the patients was neck swelling. The most common physical examination finding was the presence of a neck mass in all patients.

As a radiological imaging method, USG was performed in all patients. As further imaging methods; computed tomography n:5 (7.8%); and/or; magnetic resonance imaging n:37 (57.8%), were performed. While 28 (43.7%) of these masses were congenital, 36 (56.2%) were acquired. As a result of the radiological evaluation, it was observed that the lesions were cystic in 21 (32.8%) patients and solid in 29 (45.3%) patients, while they had mixed features in 14 (21.8%) patients. Age and gender distribution were similar between the groups (Table I).

Table I: Demographic data-radiological characteristics of patients according to groups

	CYSTIC n:21 (32,8%)	SOLID n:29 (45,3%)	MIXED n:14 (21,8%)	P Value
AGE (month)	104±68 m	68±62 m	81±60 m	0.165
Male Female	9(28%) 12 (37%)	17 (53%) 12 (37%)	6(18%) 8(25%)	0.455
Acquired	3 (8.3%)	28 (77.7%)	5(13.8%)	0.073
Congenital	18 (64.2%)	1 (3.57%)	9(32.1%)	
USG	13 (61.9%)	19 (65.5%)	11 (78.6%)	0.570
CT	0	4 (16%)	1 (7.1%)	0.131
MRI	15 (71.4%)	20 (69%)	2 (14.2%)	0.171

ABBREVIATIONS
USG: ultrasound CT: computed tomography MRI: Magnetic Resonance Imaging

The content and components of acquired and congenital lesions were similar. The smallest mass size was found to be 17.35±13.08 mm, while the largest was 32.26±20.85 mm.

While venous-lymphatic malformations (VLM) were more common among pure cystic masses; (n:9, 42.8%), hemangioma (n:14, 48.2%) was the most common solid lesion, and thyroglossal duct cyst was the most common mixed type lesion (n:8, 57%) (Table II).

Table II: Radiological typing of lesions

Lesion type	CYSTIC n:21	SOLID n:29	MIXED n:14
	Venous-lymphatic malformation n: 9 Branchial cleft cyst n:7 Thyroglossal cyst n:2 Epidermoid cyst n:2 Pyogenic granuloma n:1	Hemangioma n:14 Branchial cleft cyst n:1 Thyroglossal cyst n:1 Neurofibroma n:5 Schwannoma n:1 Dermoid cyst n:3 Lipoma n:2 Pilomatrixoma n:2	Thyroglossal cyst n:8 Epidermoid cyst n:2 Dermoid cyst n:2 Hemangioma n:1 Teratoma n:1

When evaluated in terms of the radiological location of the lesions, cystic lesions were most frequently detected in the midline (23.8%) and parotid region (23.8%). Solid lesions were most commonly seen in the anterolateral cervical triangle (24.1%), while mixed lesions were located in the midline with a frequency of 50% (Table III).

Table III: Distribution of lesions by localization

Localization	Ant. lat	facial	calvary	midline	parotid	Post.	Multi-c	Total	P value
Pathology									
Hemangioma	3	6	2	1	3	-	-	15	0.042
NF-Schwan	2	1	-	-	-	1	1	6	0.042
Glomus tm	1	-	-	-	-	-	-	1	0.042
B.C.Cyst	5	-	-	-	2	-	1	8	0.042
Thy-cyst	1	-	-	10	-	-	-	11	0.042
Lipoma-LB	2	1	-	-	-	-	-	3	0.042
VLM	-	-	-	-	2	2	4	8	0.042
Epi-derm. C	-	5	-	3	1	-	-	9	0.042
Teratoma	-	-	-	-	1	-	-	1	0.042
Pilomatrixoma	-	-	-	-	1	1	-	2	0.042
Pyogenic granuloma	-	-	-	-	-	1	-	1	0.042

ABBREVIATIONS
NF-schwan: neurofibroma-schwannoma, BCC: branchial cleft cyst, Thy-cyst: thyroglossal cyst, lipoma-LB: lipoma-lipoblastoma, VLM: endolymphatic cyst, epi-der. C: epidermoid-dermoid cyst

The treatment planning of the patients who underwent imaging was made by the relevant clinics. Thirty-two (50%) of the patients were treated surgically. Surgical excision was performed in 8 (38%) cystic masses, 11 (37.9%) solid masses, and 13 (92%) mixed masses. The pathological findings of these patients were compatible with the radiological preliminary diagnosis. At least one session of sclerotherapy was applied to 10 (15.6%) patients in the non-surgical group. The cure was achieved in all patients who underwent sclerotherapy. A non-selective beta-blocker drug was administered as medical treatment in 10 (15.6%) patients. Twelve (18.7%) patients remained in clinical follow-up (Table IV). Almost all of these patients, who were followed up for an average of 2 years, showed regression.

Tablo IV: Treatment Methods

		CYSTIC n:21	SOLID n:29	MIXED n:14
OPERATED n:32	Excision	8 (%38)	11 (%37,9)	13 (%92)
	Biopsy	0	0	1(%7,1)
NONOPERATIVE n:32	Medical	0	9(%31)	1(%7,1)
	Scleroterapy	9(%42,8)	1(%3,4)	0
	Follow-up	4(%19)	8(%27,5)	0

DISCUSSION

Neck masses are common in childhood. These masses may originate from the skin, subcutaneous fat, muscle, or bone (5). 80 to 90% of childhood neck masses are benign, and the majority are of infectious origin. Other causes include congenital malformations, benign neoplasms, and rarely malignancies. A complete history and a complete physical examination are very important for treatment planning and prognosis in these patients in order to make a correct diagnosis (6). The highest frequency of correct pre-operative diagnosis, which was based on clinical and radiological findings, was seen in cases of acquired masses (56.2 % of the cases). At the same time, the ratio of boys to girls was equal. These results were different from the data of Shuaibu et al. (7).

Ultrasound is the first-line diagnostic method to be performed in children because it is easily accessible and does not contain radiation (7). It is highly diagnostic in cases of non-inflammatory neck masses, especially in cases of congenital cystic neck masses. Vascular flow can also be evaluated with Doppler while providing information about the size, location, and content of the lesion. Mild vascularity can be observed in the septa of multilobulated, septated cystic lesions, as in Figure 1 (3).

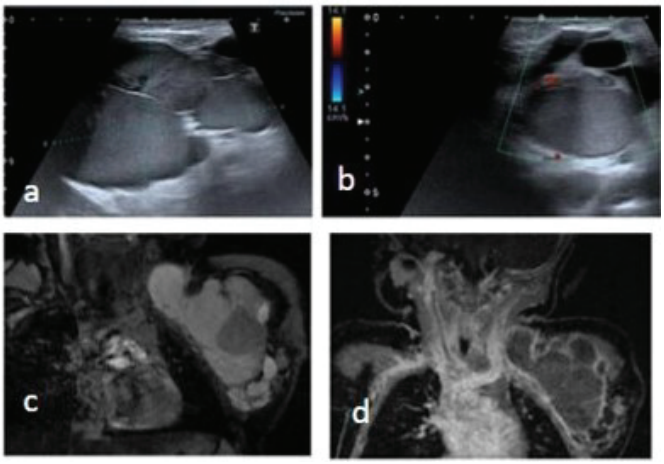

Figure 1: In a 1-year-old male patient with a giant lymphatic malformation extending from the left deltoidal region to the anteroinferior neck, the cyst was aspirated and a bleomycin injection was applied.
Figures 1a and 1b: Ultrasound and Doppler ultrasound images show vascularity in the wall and septa of the cyst.
Figure 1c: Coronal T2 weighted image shows a lobulated contoured cystic mass.
Figure 1d: Contrast-enhanced coronal fat-suppressed T1weighted shows contrast enhancement in the cystic periphery and septa.

Especially in cases of congenital cystic neck masses such as branchial, thyroglossal, and dermoid cysts, USG is highly diagnostic and eliminates the need for histopathological examination (7).

However, ultrasound is limited in case of very small or deeply located lesions (6). It is not always possible to favorably visualize deep structures of the neck, especially retropharyngeal soft tissues, using ultrasound. As in Figure 2, the extension of the solid lesion in the right carotid triangle to the deep neck structures can be better evaluated with MR. (1) CT and MR may be preferred for masses with undefined characteristics (5).

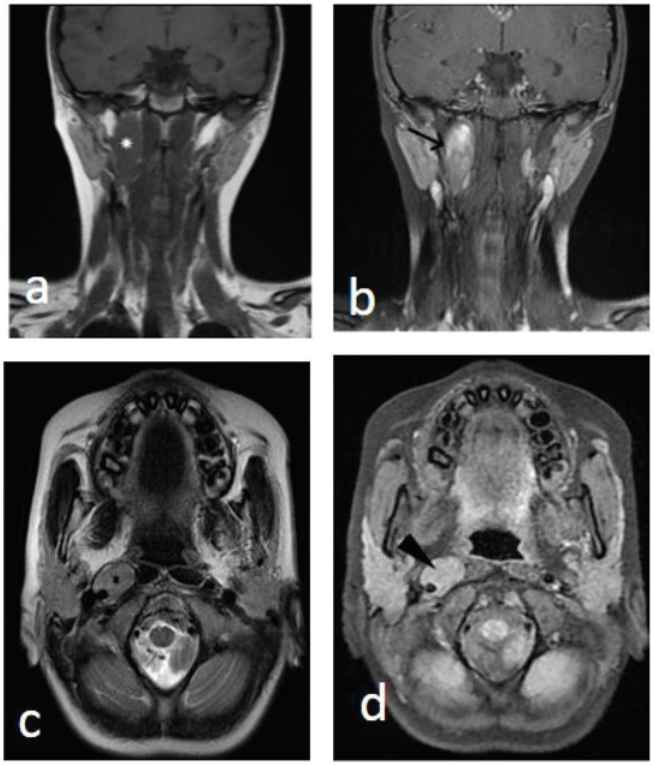

Figure 2: Operated schwannoma in the right carotid triangle in an 8 year old patient. **Figure 2a:** Coronal T1 weighted image (white point) and **Figure 2b:** contrast-enhanced coronal T1 weighted image (black arrow) shows a solid mass lesion with marked heterogeneous contrast enhancement. **Figure 2 c:** Axial T2 weighted image and **Figure 2d:** Axial contrast-enhanced T1 weighted image (black arrowhead) shows a solid mass with marked contrast enhancement.

Neck imaging in all of our patients started with USG. However, in 67.1% of our cases, CT and MR were preferred for differential diagnosis because the mass lesion was solid and mixed in character and clinically suspicious findings were present. While the rate of use of CT was 7.8% in our study, MR was used in 57.8% of the cases. CT is superior for detecting calcification, while MR may better characterize a lesion more accurately revealing its relationship with the surrounding structures, which provides important information for pre-surgical planning (4).

Presence from birth, speed of size changes, overlying skin color, erythema, fluctuation, tenderness, and high white blood cell count are among the clinical information that narrows the differential diagnosis. In these patients, cross-sectional examination has significant benefits before surgical treatment planning, or if an underlying congenital lesion is suspected (2). The most common cystic masses in the neck in childhood are thyroglossal duct cysts (7,8). Lymphatic malformations were the most common congenital purely cystic lesions in our study. Septa and remnants of proteinaceous material or internal echoes make the content of the thyroglossal cyst heterogeneous, and most of the thyroglossal cysts in our study were seen as mixed types. When all cystic lesions were examined, regardless of their content, thyroglossal cyst was the most common one in our study, which was consistent with the literature. Also we explain the reason for this by the fact that some thyroglossal duct cysts are operated without the need for radiological diagnosis.

Congenital masses encountered in childhood are generally benign and rarely malignant (5). In some suspicious cases, additional testing may be required. Normally, further investigation is often not required in the diagnosis of cystic lesions. In some cases, thyroglossal cysts can be easily recognized due to their congenital nature, midline localization, and mobility with tongue movements, but they may raise suspicion in terms of the presence of solid components on ultrasonographic imaging. The reason for this may be the protein content of the cyst, inflammation, infections, or ectopic thyroid tissue (9). Although branchial cysts are mostly cystic, atypical branchial cysts may contain solidified components that are leveled as in Figure 3.

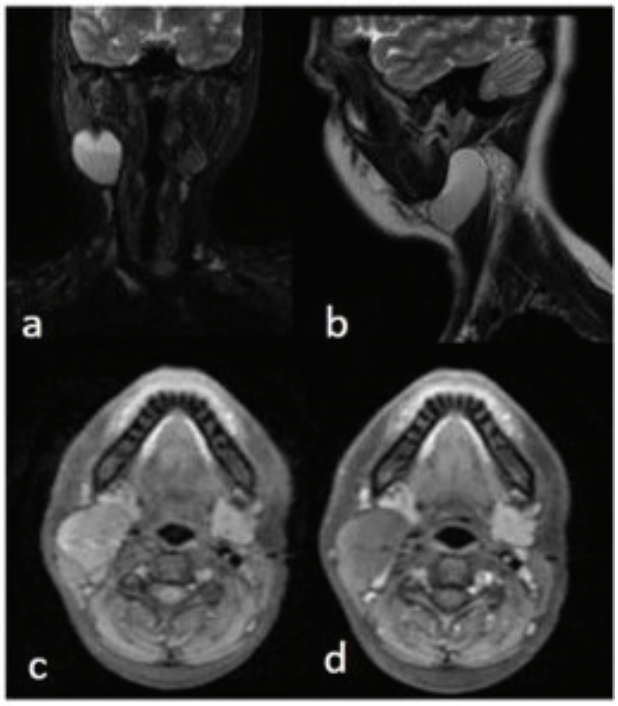

Figure 3: 16-year-old female patient, operated BKK.
Figure 3a: Coronal T2 weighted image and **Figure 3b:** Sagittal T2 weighted images show a cystic mass with leveling content on the right anterolateral neck.
Figure 3c: Fat-suppressed axial precontrast T1 weighted, and
Figure 3d: Fat-suppressed axial postcontrast images show a non-enhancing mass.

Again, cervical teratomas are mixed lesions and often contain calcifications. This may cause difficulties in diagnosis. Since the frequency of solid components was found to be 67.1% in this series, the history, and physical examination were not satisfactory, and additional examination was required to clarify the diagnosis and to show its relationship with the extension and surrounding tissues. In order not to miss a possible malignancy, it is important not to avoid further examination. Another radiological guide is the location of the lesion. Embryonic features and anatomy of the cervical region help narrow the differential diagnosis of neck lesions in children (9). In the presented series, mixed thyroglossal cysts were located in the midline, whereas branchial cysts, and solid lesions such as hemangiomas were located more often laterally. These findings were consistent with the literature (10). Venous-lymphatic malformations mostly had multi-compartment localization. Imaging methods have a significant role in the diagnostic journey of children presenting with a congenital or acquired mass in the neck. Radiology is both guiding and helpful in the treatment and follow-up of interventional procedures (10). Sclerotherapy application was performed under US guidance in our patients. Besides its diagnostic use, ultrasound was used as a noninvasive method at follow-up visits in the patients who did and did not receive medical treatment in order to determine the lesion's depth and size and if the lesion regressed. After the diagnosis is clarified clinically and radiologically, surgical excision is satisfactory for masses that show spontaneous regression or that are not eligible for nonsurgical treatment methods. Excision is the recommended treatment method, especially in patients with congenital neck masses, to prevent problems such as future growth and secondary infection (7). In the presented series, half of the patients were treated surgically and the other half were treated non-surgically. Cure can be achieved by aspiration and sclerosing agent injection therapy performed by interventional radiology in lymphatic malformations which have a high risk of recurrence when operated. The limitation of our study was the fact that a selected group and a limited number of patients were included in this retrospective study. Further studies with higher numbers of patients are needed.

CONCLUSION

The etiology of childhood head and neck masses is quite diverse. Therefore, no clinical or radiological feature alone can predict the definitive diagnosis. Adopting a multidisciplinary approach in a complete and adequate clinical evaluation is extremely important to guide the selection of appropriate medical and/or surgical treatment.

Highlight key points:

1) The purpose of imaging is to minimize radiation exposure while obtaining an effective diagnosis or differential diagnosis.
2) It is extremely important to adopt a multidisciplinary approach to clinical and radiological lesions and to guide the selection of appropriate medical and/or surgical devices.
3) Head and neck masses in childhood have a wide variety of causes.

Ethics Committee Approval:
This research complies with all the relevant national regulations, institutional policies and is in accordance with the tenets of the Helsinki Declaration, and has been approved by the S.B Istanbul Medeniyet University Göztepe Training and Research Hospital (approval number: (ID:2022/0555).

Informed Consent:
Since the data used in the study were obtained from retrospective medical data, written informed consent was not obtained.

Author Contributions:
Concept – GB.; Design – GB, NG.; Supervision –NG.; Funding - no.; Materials – Data Collection and/or Processing –GB, NG.; Analysis and/or Interpretation –GB.; Literature Review – GB, NG; Writing – GB.

Conflict of Interest:
The authors have no conflicts of interest to declare.

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