

## Ultrasonography in pediatric neck cystic lesions

Ahmad Hesari <sup>1</sup>, \* Masoud Mahdavi Rashed <sup>2</sup>

<sup>1</sup> Student research committee, Mashhad University of Medical Sciences, Mashhad, Iran.

<sup>2</sup> Department of Radiology, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran.

### **Abstract**

Diagnosis of the cystic lesion of the neck in pediatric cases is challenging for radiologists. There are different cystic lesions in the neck region that can present themselves in various parts of this area. Some lesions may lie in the middle parts and some in the lateral areas; however, some cystic defects can be present in every part of the neck. Sonography is the first modality for the assessment of the cases, along with history and physical examination. Sonography is nearly accessible and is not expensive; however, it depends on the expertise of the sonographer. We reviewed sonography findings of various cystic lesions in the neck region and reported the findings with this regard.

**Key Words:** Cystic lesion, Neck, Pediatrics, Sonography.

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### **\*Corresponding Author:**

Masoud Mahdavi Rashed, Department of Radiology, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran. Email: mahdavirm@mums.ac.ir

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## 1- INTRODUCTION

Cystic lesions of the neck comprise a wide variety of differential diagnoses. Usually, these cysts fall into three categories including inflammatory or reactive, congenital or developmental, and neoplastic (1). However, around 90 percent of the cervical cysts are benign (2).

The management of the cervical cystic lesions is complex and is conducted according to the history and physical examination data along with radiology findings. Even in some cases the diagnosis is made only after the surgical resection and pathology assessment of the cyst. The history of recent infection or insect bites should be focused on. Also, the onset and the duration of the mass have clinical significance for the diagnosis (3).

The location of the mass is another important finding. Some cystic masses are only present in the midline area of the neck and some present themselves laterally. Moreover, the lateral part of the neck is composed of anterior and posterior triangles (4). Different imaging modalities may be used in case of cervical cystic lesion diagnosis; however, sonography is more popular and is usually used as the first modality. This is due to the fact that sonography poses no radiation, is easily accessible, and has a nearly reasonable price (5). Here, we tried to review different cystic lesions of the neck region and assess their sonography findings.

## 2- MATERIALS AND METHODS

Different keywords including sonography, ultrasound assessment, and different types of neck cystic lesions were used to search various databases including Scopus, Pub-Med, and ISI web of science. Moreover, Google scholar was reviewed and the available results were entered. Title and abstract of the included studies were assessed for the relevant studies and the full texts were also evaluated for data extraction. Different cervical cystic masses

were reviewed and sonography features were reported. Only studies with acceptable quality were enrolled in the review.

## 3. RESULTS AND DISCUSSION

### 3-1. Central masses

#### 3-1-1. Thyroglossal duct cyst

The most common cystic lesion of the head and neck region is Thyroglossal Duct Cyst (TGDC), accounting for seven out of every ten neck cystic masses in children. TGDC comprises around 17 percent of all congenital abnormalities in children with equal affection of both males and females (6). Moreover, it is reported that TGDC is responsible for 70 percent of head and neck masses in the general population (7). This congenital mass comprises the remainder of the thyroglossal duct, which is an embryonic organ. Thyroglossal duct is an embryonic tissue that its distal part gives rise to pyramidal lobe of thyroid in about half of the cases. The remaining part should be obstructed by the age of ten weeks; however, it may remain totally or partially open after this age (8). TGDC usually presents itself during the start of school period (3).

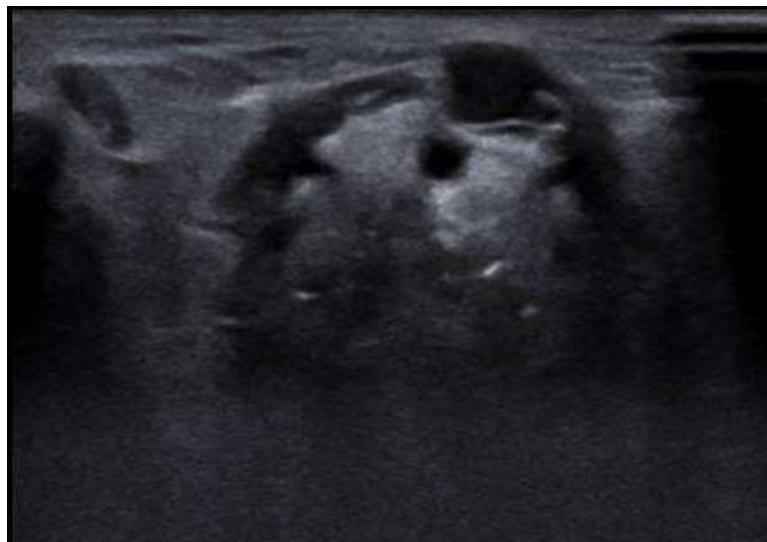
TGDC may present as a cystic mobile mass adjacent to the hyoid bone at the midline part of the neck. Most commonly, the mass presents itself at the infrahyoid part of the neck, as it is evident in 25 to 65 percent of the cases. Around 20 to 25 percent of the cases may present suprahyoid TGDC and 15 to 20 percent are at the level of hyoid bone (9, 10). It can be asymptomatic or can present itself as draining sinuses or abscess. Moreover, it can cause bulging of the tongue (11).

Sonography is a helpful modality in case of diagnosis of TGDC. It is reported that there may be some differences between adults and children in case of sonography features of the TGDC (12). Ahuja et al. (13) proposed that the presence of pseudo

solid pattern is the most common ultrasound finding in TGDC that is present in 56.5 percent of the cases, followed by heterogeneous pattern (30.5%) and anechoic (13%). Oyewumi et al. (14) also proposed the presence of ill-defined margin, irregular wall, tract, solid components, internal septae, and intralesional Doppler flow in the sonography findings of TGDC cases. They also proposed that the presence of one of these symptoms is suggestive for TGDC and the presence of two or more of these symptoms is highly suggestive for TGDC. However, if none of the above-mentioned ultrasonography findings were present, a diagnosis of dermoid cyst is more possible. Typical findings of a TGDC are present in 50 percent of the cases and include a thin-walled anechoic unilocular cyst. The high protein content instead of presence of inflammation, causes a hypoechoic or heterogeneous pattern presenting as

pseudocyst or resembling ectopic tissue (15, 16). The majority of the TGDC cysts show posterior acoustic enhancement. Moreover, another useful finding is the absence of color doppler flow (15, 17).

Oyewumi et al. (14) proposed septae + irregular wall + solid components equal TGDC, abbreviated as SIST score. Tokarz et al. (18) also assessed the reproducibility of CYST in differentiating TGDC from dermoid cyst. Correct diagnostic prediction rate was 67 percent among two pediatric radiologists according to the gold standard diagnosis of pathology. This differentiation is important, in case of surgical management, as the surgical removal of TGDC is more challenging. Moreover, when a TGDC is suspected, an ultrasound assessment of the thyroid gland should be conducted in order to rule out the presence of an ectopic tissue (19, 20). **Fig. 1** shows a sonography view of the TGDC.



**Fig. 1:** Thyroglossal duct cyst near midline; a cyst lesion inferior to hyoid in strap muscle

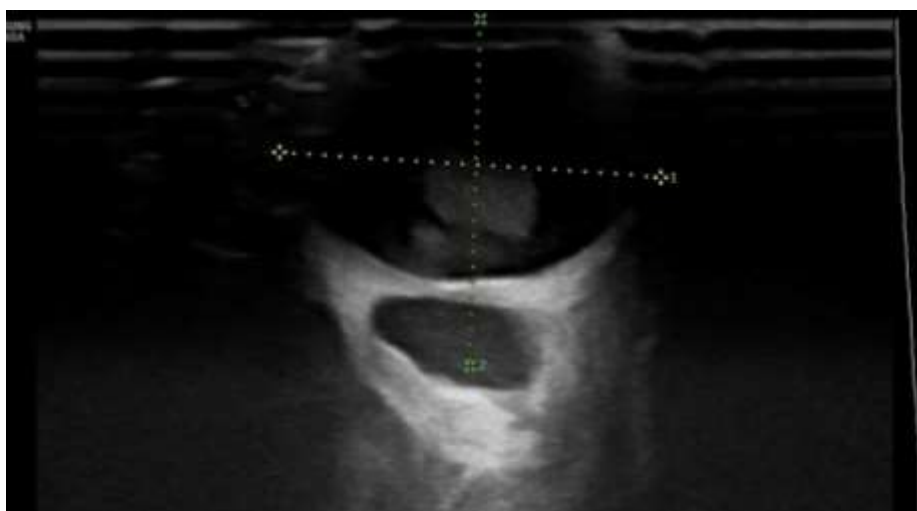
### 3-1-2. Dermoid cyst

Dermoid cysts are among the most common benign tumors of the head and neck region in children. It is reported that 61 percent of dermoid cysts are located

periorbital and 18% are located in the neck region, as the second most common site (21). It is reported that around 70 percent of the dermoid cyst cases are found in children aged less than 5 years old (22). The common site of the dermoid cyst in

the neck is the anterior midline part, just like TGDC (23). Dermoid cysts usually present a unilocular well-defined oval or round shaped homogeneously hypoechoic mass with thin walls in ultrasonography that resembles pseudo solid pattern. Due to the presence of fat components, mixed echoes may also be present. In addition, calcification can cause posterior shadowing. Moreover, unlike TGDC that

is usually stationed intramuscularly, dermoid cysts usually are situated subcutaneously (17). A positive predictive value of 80% for shadowing echogenicity, 75% for regionally bright echoes, 50% for hyperechoic lines and dots, and 20% for fat-fluid level is observed for dermoid cyst (24). Dermoid spherule is a specific sign for dermoid cyst (25). **Fig. 2** shows sonography features of the dermoid cyst.



**Fig. 2:** Dermoid cyst: midline cyst in the floor of oral cavity with a hyper echo oval floating lesion (dermoid spherule)

### 3-1-3. Epidermoid cyst

Epidermoid cyst or sebaceous cyst is a benign keratin containing subepidermal cyst. Like dermoid cyst, epidermoid cyst can be found elsewhere in the body, with higher prevalence in the head and neck region. These cysts are the most common cutaneous cysts, which are found to be two times more prevalent in males compared to females (26). Sonography shows a hypoechoic cystic or cystic to solid well-defined oval/round mass with slight or no posterior sound enhancement (27). The location of the mass and its relation to the surrounding tissue is important in the diagnosis, as it lies in the dermis and subcutaneous tissue. Dorsal acoustic amplification and lateral shadowing phenomena are other ultrasound clues for

epidermoid cyst. In a rare number of cases, a tubular shape may be found (28, 29). The size of the cysts ranges between 1 and 6 cm. These cysts may present inner echogenicities that are indicative of debris. Furthermore, the highly compacted deposits of keratin and cholesterol may result in a pattern of brighter inner echoes and anechoic filiform areas. Commonly, a connecting anechoic tract to the epidermis (punctum) can be detected on ultrasound. No color Doppler signals are present in this type of cyst; however, there may be twinkling artifacts and variable echogenic foci in the hypoechoic cystic mass. During the rupture of the cyst, the secretion of keratin causes reactive inflammatory state in the surrounding tissues, and results in hypoechoic fluid collection. During the

inflammatory phase a low peripheral blood flow can be noted in the surrounding tissue (29).

### **3-2. Plunging ranula**

Plunging Ranula (PR) or cervical ranula is a congenital or acquired pseudocyst malformation that is caused by the obstruction of a sublingual gland, which is usually submandibular or sublingual salivary gland. The name is derived from the term rana that means frog in Latina and demonstrates the swelling of the floor of the mouth (30). It is reported that the condition is rare in children aged less than 10 years old (31).

The symptoms of PR include the presence of a non-tender bluish fluctuating swelling in the neck that can move freely. The size of the cyst is about 4 to 10 cm. The location of PR is usually in the submandibular area but it may extend to the cervical region. In fact, there are three different types of granules according to the location of the cyst. Oral or superficial ranula that develops supra mylohyoid muscle. Cervical ranula is termed plunging ranula, which is demonstrated by infra mylohyoid muscle. Moreover, there may be both oral and plunging ranulas, termed as mixed ranula (30). The prevalence of ranula is 2 per 10000 cases in the general population (32); however, PR is found in around 100 cases (33).

The differential diagnoses of PR are TGDC, dermoid/epidermoid cysts, and thyroid cyst or glottic cyst. There is no consensus in case of the imaging of the choice for PR. Still, sonography can show useful findings. Sonography of the cases shows an anechoic, low echoic, or mixed echoic lobulated or ovoid cystic mass that is partly solid and partly liquid (31).

### **3-3. Lateral masses**

#### **3-3-1. Branchial cleft cyst**

The branchial apparatus is an embryonic tissue that contributes to the formation of

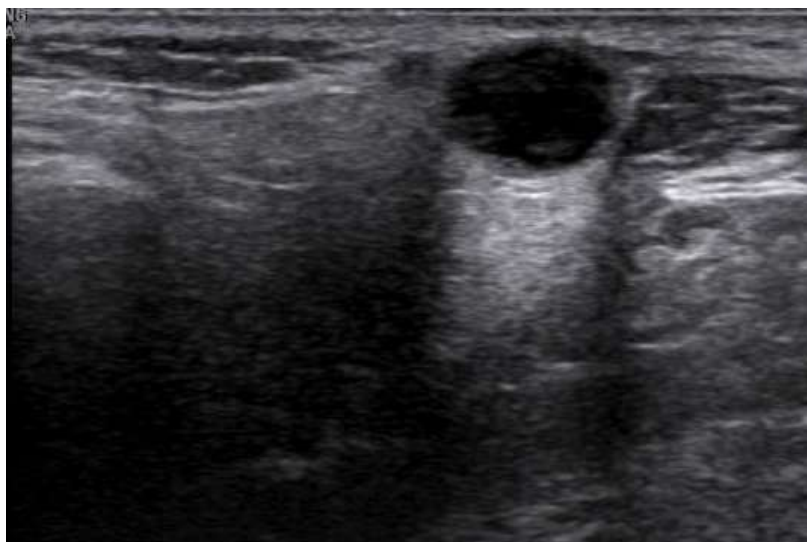
the head and neck muscles, bone, and cartilage tissue. The apparatus is composed of four pairs of arches separated externally by four paired grooves and internally by four paired pouches. Branchial cleft cyst can arise as a malformation in one of the fourth branchial clefts; but in around 90 percent of the cases, the anomaly of the second branchial cleft is responsible for the problem (34). Branchial cleft cyst constitutes in around 25 to 30 percent of the head and neck masses and with this regard can be listed as the second most common cystic lesion of this region (35, 36). The anterior triangle of the neck is the most common site of the branchial cleft cyst (36). However, according to the type of branchial cleft anomaly, the site of affection may differ. It is reported that less than 10 percent of branchial cysts are due to the first branchial cleft anomalies. These cysts typically present themselves at the angle of mandible, and they may be embedded in the parotid gland and thus a relationship with facial nerve can be seen in many of the cases. Moreover, they may be extended to the external auditory canal by a tract. The first branchial cyst is further classified into two types including work type I that is presented preauricular, extending to ear canal or middle ear and work type II that is located at the angle of mandible, extending to concha of ear canal (37).

The second branchial cyst presents itself as a unilateral cyst located adjunct to the jugular vein and it is usually right sided in presentation. According to the time of defect development during embryology four types of affection site may be presented including deep in platysma muscle (type I), anterior to the sternocleidomastoid (type II), near carotid sheath and posterior to the submandibular gland (type III), and near the pharyngeal wall (type IV) (36).

The third and fourth pharyngeal cysts also present themselves superior and inferior to

the laryngeal nerve, respectively. The most common emergence site of the third pharyngeal cyst is posterior cervical space. A fourth branchial cleft fistula or sinus tract arises from the pyriform sinus apex and descends inferiorly into the mediastinum along the path of the

tracheoesophageal groove (38). Branchial cyst presents itself as an oval or round well-defined mass with thin walls and hypo- to an anechoic pattern. The mass may also show compressive symptoms (34, 39). **Fig. 3** and **Fig. 4** show branchial clefts of type 1 and 2, respectively.



**Fig. 3:** A small cystic lesion with posterior enhancement in parotid. Branchial cleft cyst type 1; Necrotic lymph node and lymphoepithelial cyst are most common DDXs



**Fig. 4:** A branchial cleft cyst type 2: cystic lesion between SCM and submandibular gland

### 3-3-2. Cervical thymic cyst

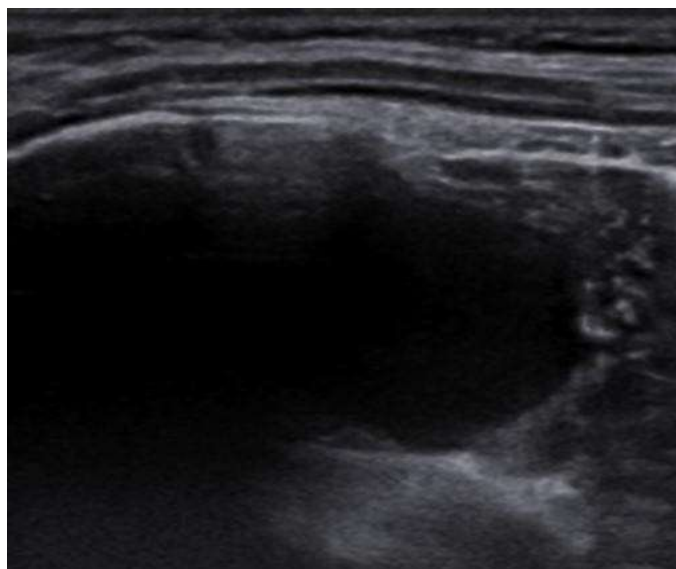
Cervical Thymic Cyst (CTC) is one of the uncommon cystic lesions of the neck

accounting for less than 3 percent of the cervical cystic lesions, with a male predominance in case of epidemiology



(40). CTC can be congenital or acquired. Congenital CTC occurs due to inflammatory processes. In case of congenital CTC, it should be noted that the embryonic origin of thymus is the third and fourth pharyngeal pouches (41). The cyst is usually formed in the way that the thymus forming tissue descends toward anterior mediastinum, which is a way from the angle of mandible toward superior mediastinum (42). The cysts usually appear between ages 6 and 7 years and present as a soft swelling, residing in the

left neck region anterior to the sternocleidomastoid muscle; and can extend to the superior mediastinum in about half of the cases (40). A septate or lobulated well-circumscribed cystic lesion with internal echo is usually found in ultrasonography and the echo of the thymic tissue may be present, as well (43-46). Moreover, large cysts can show compressive symptoms like displacing the carotid sheath and the submandibular gland (47). **Fig 5** shows a sonography image of a cystic lesion in thymus.



**Fig. 5:** from suprasternal view there is a cystic lesion in thymus that protrudes to lower neck

### 3-4. Laryngocele

Laryngocele is an enlargement in the laryngeal saccule. The condition may be internal and have no visibility at the surface of the skin or may be external and protrude laterally on the neck surface (48). The saccule, or laryngeal appendix, is a blind pouch cranially extending from the anterior aspect of the laryngeal ventricle within the supraglottic fat (49). Internal laryngocele can cause hoarseness, stridor, and even respiratory distress (50). Neonatal laryngocele is very rare and involves 1 per every 2.5 million cases in the general population (51). The

ultrasonography definition of the cystic mass is an echo-free or hypoechoic, well-defined structure inside the thyroid cartilage (52). The topography of the cyst can be also helpful, as it resides near the laryngeal wall (53).

### 3-5. Other lesions

#### 3-5-1. Cystic Lymphangiomas

Lymphangiomas are other congenital benign cystic lesions that appear in head and neck regions, as the most common infection sites (54). About 75 percent of lymphatic lesions occur in the head and neck and the majority of them are

diagnosed before the age of 2 years (55). Lymphangiomas are classified as microcystic (capillary lymphangiomas), macrocystic (cavernous lymphangiomas) and cystic hygromas according to the size of the lymphatic cavities incorporated (56). The condition usually presents itself early in life and usually has a hard surgical removal (57).

Lymphangiomas manifests itself as well circumscribed multiloculated cystic anechoic mass with thin walls that can have thin septa. There may be variable thickness for septa; and solid components may be present. However, vascularity is absent in Doppler imaging (58). Occasionally, an echogenic area may be identified within the lesion due to clusters of small abnormal lymphatic channels. Fluid–fluid areas can also have a dependent and layered echogenicity if there is a hemorrhagic component (59).

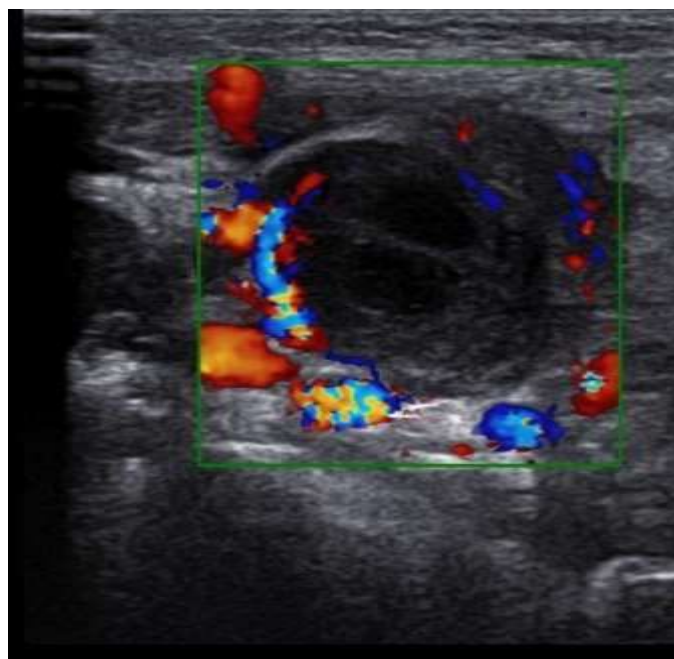
### 3-5-2. Venous malformations

Rarely venous malformations may present as cystic lesions in the neck. These masses

have a deep blue to purple color, collapses with posing pressure, and swellings with exertion. Moreover, in auscultation, a bruit sound may be detected that is useful for diagnosis. The ultrasonography pattern of venous cystic malformations is heterogeneous and vascular channels with various sizes may be detected that are compressible. Monophasic, low-velocity venous flow is also detected in color doppler imaging (60).

### 3-5-3. Suppurative lymphadenitis

Lymphadenitis may happen in every part of the neck and may resemble cystic lesions. The most common locations include submandibular, parotid space, and retropharyngeal. Abscess shows a typical sonography finding, which is an anechoic or hypoechoic mass with peripheral thick shaggy margins. Moreover, signs of inflammation and edema are present in the surrounding tissue (61, 62). **Fig. 6** shows a sonography image of a suppurative lymphadenitis.

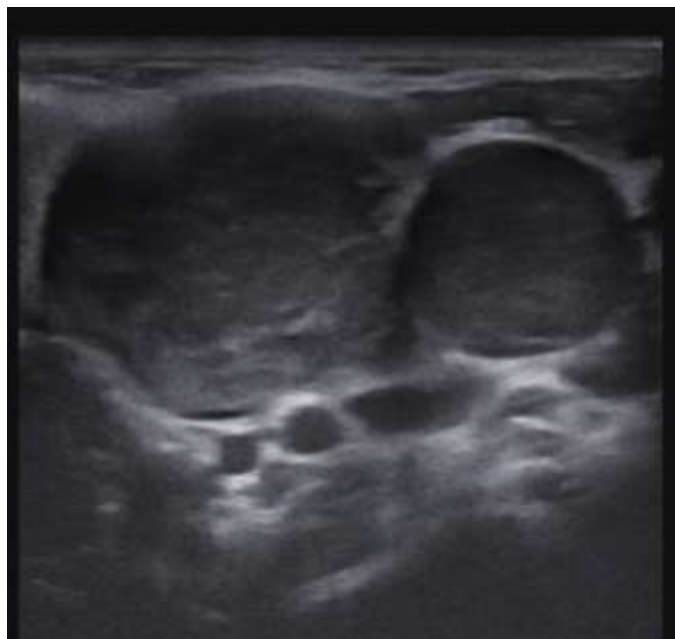


**Fig. 6:** Suppurative lymphadenitis, abscess formation, and peripheral inflammation with avascular hypo echo and heterogeneous cystic appearance



There can be some very hypoechoic lesions that resemble a cystic malformation; however, it is not similar to other cysts and can be regarded as pseudocyst. **Fig. 7** also demonstrates an ultrasound view of lymphadenopathy that

resembles cystic lesions. However, the presence of vascular flow and lack of posterior enhancement in color doppler are characteristics that differentiate cysts from pseudocysts.



**Fig. 7:** Very hypoechoic lymphadenopathy in a patient with lymphoma that resembles cystic lesion. Vascularity in Doppler and absence of posterior enhancement can help differentiate it from cysts.

#### 3-5-4. Cervical cystic teratoma

Teratomas are germ cell tumors with congenital origin and extragonadal involvement. A rare location of teratoma is in the neck region that can be found in both lateral and middle neck areas. It is reported that less than 5 percent of teratomas present themselves in the neck region; and cervical teratomas account for 1 to 2 cases in every 40000 live births (63). Teratomas consist of three embryonic layers and thus the immature teratoma grows rapidly until becoming mature. This rapid growth causes large masses that pose compressive effects on adjacent organs. These compressive symptoms include facial disfigurement, orbital involvement and respiratory distress. Due to these symptoms, the diagnosis is usually early.

Teratoma is associated with maternal polyhydramnios in 30% of cases.

Cervical teratoma is found as a large multiloculated, multiseptated, and heterogenous mass with cystic and solid components that is located in the anterior or anterolateral part of the neck. Moreover, in around half of the cases, scattered areas of calcification may be found (64). Antenatal diagnosis by sonography is also possible in some cases. Moderate vascularization of the tumor can be found in color doppler sonography, too (65).

#### 3-5-5. Vallecular cyst

Vallecular cyst is an extremely rare cyst that is probably caused by obstruction of submucosal glands and subsequent mucous retention. The mass usually originates

from valleculae at the base of the tongue or different tissues around this part. Most of the cysts are small and remain asymptomatic in the patients. However, large cysts can cause life threatening distress during anesthesia, due to the possible effects on adjacent organs (66). Sonography can show a midline well circumscribed anechoic lesion with some debris. The relationship of the cystic mass with the base of the tongue can also be helpful (67).

#### 4- CONCLUSION

We reported the ultrasound findings related to different cystic lesions in the neck region in pediatric cases. The findings can be helpful in differentiating neck cystic lesions from each other. Distinguishing these lesions is, in fact, very important, as the management may be different. However, a combination of the location of the cyst, examination, and sonography findings can yield the final diagnosis. Still, most cystic lesions are rare and a final diagnosis is achieved only after histologic assessment.

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