

ORIGINAL ARTICLE

# Radiological Assessment of Congenital and Developmental Neck Lesions in Paediatric Patients

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**ABSTRACT**

**Background:** Some combination of different imaging modalities is often necessary in the diagnosis and / or management of a pediatric neck mass. The decision of which imaging modality to order often requires discussion with the radiologist as well as careful consideration of factors, such as radiation exposure, cost and accessibility.

**Objective:** The present study was undertaken with the following objective to assess the morphology and structural characteristics of developmental and congenital mass lesions of neck in pediatric patients on high resolution Ultrasonography (USG), Colour Doppler flow study, Computed Tomography (CT-scan) and Magnetic Radiography Imaging (MRI).

**Materials & Methods:** This study was carried out in the department of Paediatric surgery, from June 2017 to June 2019 with help of Department of Radiodiagnosis. Thirty eight pediatric patients with congenital/developmental neck mass lesions were evaluated on USG and Colour Doppler Flow study among which some of them underwent CT and MRI.

**Results:** Most common age group in present study was 0-4 years with slight female predominance (male : female ratio of 6:8). The most common neck mass lesion in present study was cystic hygroma making 28.9% of total disease burden followed by thyroglossal duct cyst (18.4%) and lymphovenous malformation (15.8%). On Sonography most of the lesions were found to be multiloculated with thick internal septas (45.5%). Variable CT scan and MRI features are present in different congenital neck lesions.

**Conclusion:** Imaging is increasingly demanded for its investigation and differentiating the nature of the mass, establishing and narrowing the diagnostic possibilities, and evaluate the anatomic extent for those lesions requiring surgical treatment.

A palpable neck mass is a common finding in pediatric patients and it may result from congenital anomalies, inflammatory

and/or infectious processes, or less commonly neoplasms. Congenital lesions are one of the most frequent etiologies.

Imaging is increasingly demanded for its investigation and the role of the radiologist is to help differentiating the nature of the mass, establishing or at least narrowing the diagnostic possibilities, and evaluate the anatomic extent for those lesions requiring surgical treatment.

Plain Radiography can be used in initial evaluation in children presenting with airway compromise due to portability, speed and ability to quickly assess for critical diagnosis requiring immediate intervention. However, radiography is limited in characterizing the morphology of neck masses. Hence Highresolution ultrasound (US) has become an ideal initial imaging investigation for neck masses as it reveals the cystic nature in most cases and localizes the mass in relationship to the surrounding structures. Development of threedimensional technology, Colour and Power Doppler applications has led to great improvement in its diagnostic utility.

Computed Tomography (CT) is superior as it confirms the findings of Ultrasound, determines the extent of lesion, and is especially useful in demonstration of calcification or fat within the lesion. But its utilization in the pediatric population is limited because of concerns about exposure to ionizing radiation. Technical options are now included in newer CT scanners like X-ray beam filtration and collimation , tube current modulation tailored to patient size and indication , peak kv optimization to reduce the radiation dose.

Magnetic Resonance Imaging often provides the most detailed characterization of soft tissue neck masses. MRI has a supplementary role in work up of cystic neck masses. Its multi planar capability and superior contrast resolution allow precise preoperative anatomical localization, particularly for more deep seated and locally extensive lesions.

Ultimately some combination of different imaging modalities is often necessary in the diagnosis and / or management of a pediatric neck mass. The decision of which imaging modality to order often requires discussion with the radiologist as well as careful consideration of factors, such as radiation exposure, cost and accessibility.

Keeping the above objectives in mind the present study has been done to assess the morphology and structural characteristics of developmental and congenital mass lesions of neck in pediatric patients on high resolution Ultrasonography, Colour Doppler flow study, MD-CT and MRI.

## **MATERIALS AND METHODS**

The study was carried between June 2017 to June 2019

taking ethical clearance. Thirty eight pediatric patients with congenital/developmental neck mass lesions were evaluated on ultrasonography and Colour Doppler Flow study among which some of them underwent CT and MRI. The observations regarding 38 patients have been analyzed.

**Results:** Most common age group in present study was 0-4 years with slight female predominance (male: female ratio of 6:8).

The most common neck mass lesion in present study was cystic hygroma making 28.9% of total disease burden followed by thyroglossal duct cyst (18.4%) and lymphovenous malformation (15.8%).

Cystic hygroma and lymphovenous malformation were commonly seen in the age group of 0-4 years while hemangioma, branchial cleft cyst and epidermoid cyst were more commonly seen in the age group of 13-16 years. Thyroglossal cyst was encountered in the age group of 5-16 years. Most of the TGC were in midline (71.4%) and infrahyoid location (85.7%), thin walled having size < 3cm. On ultrasonography all the lesions were well circumscribed, unilocular with well defined margins .Regarding internal appearance anechoic, hypoechoic and pseudosolid appearance were observed in equal proportions(28.6%). Most of the lesions showed posterior acoustic enhancement. On CT all the lesions were well circumscribed, unilocular with well defined margins having homogenous fluid attenuation. Two of the four cysts showed peripheral wall enhancement.

On MRI two of the three lesions showed homogenous signal intensity which were uniformly hypointense on T1 and uniformly hyperintense on T2 weighted images. Majority of the cystic hygromas were seen in posterior cervical space (54.5%) and on left side of the neck (72.7%). Most of the lesions were seen infiltrating into adjacent neck spaces having size greater than 5 cm. On Sonography most of the lesions were found to be multiloculated with thick internal septas (45.5%).

On CT all the lesions showed homogenous fluid attenuation. Four of the six lesions were multiloculated with enhancing internal septations.

On MRI all the four lesions showed homogenous signal intensity which were uniformly hypointense on T1 and uniformly hyperintense on T2 weighted images and showed internal septations.

Majority of the lymphovenous malformation were located in submandibular spaces (83.3%) with right sided predominance. All the lesions were seen infiltrating into adjacent neck spaces while three of the cases showed B/L

involvement crossing midline. On ultrasonography all the lesions were multiloculated with internal septations and showed muscle involvement. Two lesions showed internal fluid- fluid levels and phleboliths. On Color Doppler study all the lesions showed low velocity monophasic flow. All the lesions showed homogenous fluid attenuation on non contrast CT with mild septal enhancement in arterial phase and gradual persistent opacification of vascular channels in venous and delayed phases.

On MRI all the lesions were hypointense on T1 and hyperintense on T2 weighted images with visible internal septations. Two of the five lesions showed focal T1 hyperintensity (40%).

50 % of hemangiomas were located on right side. Two of the four lesions were located in submandibular space and the rest two in parotid space. On ultrasonography all the three lesions showed internal soft tissue component with dilated vascular channels showing low resistance arterial flow and venous flow .

On CT the lesion showed soft tissue attenuating component with internal dilated vascular channels. Fifty percent of the epidermoid cysts were in midline .All the lesions were thin walled. On ultrasonography two of the four lesions were well circumscribed and the rest two were of infiltrating type. Most of the lesions were hypochoic with homogenous internal debris (75%) and showed posterior acoustic enhancement. On CT two of the three lesions showed homogenous fluid attenuation. All the lesions were unilocular with well defined margins. On MRI epidermoid cyst was unilocular and showed homogenous signal intensity without internal fat intensity areas.

Both dermoid cysts were in midline; one was in suprahyoid and the other was in infrahyoid location. Both of the lesions were thin walled measuring more than 3 cm. On ultrasonography both the lesions were unilocular with coarse internal echoes. On CT the dermoid cyst appeared heterogenous with internal fat attenuating areas.

On CT both 1<sup>st</sup> branchial cleft cyst and type 1, 2<sup>nd</sup> branchial cleft cyst were well circumscribed, thin walled with homogenous fluid attenuation. On Ultrasonography, type 3, 2<sup>nd</sup> branchial cleft cyst was well circumscribed, thin walled, unilocular, hypochoic with homogenous internal debris showing posterior acoustic enhancement.

In this rare case of triple thyroid ectopia, the lesions were located at the base of tongue, at the level of hyoid and infrahyoid regions. The lesions showed homogenous enhancement on contrast enhanced CT.

## DISCUSSION

Ultrasonography is the initial imaging modality of choice in pediatric population and most often the results can suggest the correct diagnosis (Koeller *et al.* 1999). CT or MR imaging is sometimes required to study the extent of the lesion. CT aids in the morphologic characterization of neck masses and allows precise visualization of fine bone structures, calcifications, and deep soft-tissue compartments that cannot be demonstrated with Ultrasound (Sajedi and Shet 2016). Magnetic resonance imaging is often preferred over CT imaging in the non emergency setting because of its lack of radiation exposure (Friedman *et al.* 1983).

### Epidemiological Interpretations

Thyroglossal ducy cyst showed a slight female predominance (Ahuja *et al.* 1999). However some study suggest no gender predilection (Koeller *et al.* 1999). This female predominance might have occurred because of small study population. Cystic hygroma showed a slight male predominance in the present study. There was no gender predilection in previous study cystic hygroma (Zadvinskis *et al.* 1992). This discordance might be again due to small study population. According to previous studies the size of the cystic hygroma is extremely variable ranging from few millimetres to more than 10 cms. In the present study all the lesions were larger than 5 cm.

Previous study (Koeller *et al.* 1999) observed that cystic hygromas are characteristically infiltrative in nature and do not respect fascial planes. This is in concordance with the present study where 8 out of the lesions were seen infiltrating into adjacent neck spaces.

Most of the cystic hygromas were poorly circumscribed, multilocular, separted with fluid attenuation and higher density (Fig. 1a) could be seen rarely in case of infection or hemorrhage in CT scan. Most common pattern of cystic hygromas in MRI is low or intermediate signal intensity on T1-weighted images and hyperintensity on T2-weighted images (Fig. 1b) and Infrequently may be hyperintense on T1-weighted images a finding associated with clotted blood or high lipid content (Zadvinskis *et al.* 1992).

### Thyroglossal cyst

In the present study 71.4 % lesions were located in midline, 28.6% lesions were off midline, 85.6% lesions were at infrahyoid level and 14.3 % at hyoid level (Koeller *et al.*

1999; Ahuja *et al.* 1999) showed that the size of the TGCs measured between 8 and 33 mm and all the lesions were had well defined margins, unilocular (Ahuja *et al.* 1999).

In the present study, anechoic, hypoechoic and pseudosolid pattern were observed in equal proportions (28%) while one lesion showed heterogenous pattern (Koeller *et al.* 1999). In present study 71.4 % lesions showed posterior acoustic enhancement, which is in concordance (Koeller *et al.* 1999; Ahuja *et al.* 1999), well circumscribed with homogenous fluid attenuation and 2 out of the 4 lesions showed peripheral wall enhancement (Koeller *et al.* 1999).

In present study, 2 out of the three lesions were hypointense in T1 and hyperintense in T2 weighted images while one of the lesions showed heterogenous signal intensity (Koeller *et al.* 1999).

### **Lymphovenous malformation**

The most common age group of vasculo lymphatic malformation in the present study was 0-4 years in which most of the lesions were observed since birth and there was no gender predilection (Koeller *et al.* 1999). Most common location for the malformation in the present study was anterior submandibular space (Bhat *et al.* 2014).

In present study, where all the 6 lesions were seen infiltrating into adjacent neck spaces and 3 of the lesions were seen crossing the midline (Koeller *et al.* 1999).

In sonography all the lesions were multilocular with (Fig. 2) internal septas of varying thickness which is in concordance with the study by (Sheth *et al.* 1987).

The present study where all the 6 lesions showed low velocity monophasic venous flow on colour Doppler study All the six lesions showed muscle / salivary gland involvement in the present study which is a characteristic feature for the venous component of the lesion (Bhat *et al.* 2014).

In CT angiography both the lesions showed homogenous fluid attenuation in non contrast study with mild septal enhancement in arterial phase and gradual persistent opacification of vascular channels in venous and delayed phase (Bhat *et al.* 2014) (Fig. 3).

On MRI all the five lesions were hypointense on T1 and hyperintense involvement in present study lesions in the present study (Bhat *et al.* 2014).

### **Hemangioma**

The most common age of presentation of hemangioma

according to is infancy and were classified into involuting and non involuting type (Koeller *et al.* 1999). In the present study, the lesions were equally distributed in the age groups of 5-8 and 9-12 years and was more common in age group 13-16 years. However, all the lesions were present since birth. on sonography hemangiomas could be either hypoechoic or hyperechoic with dilated vascular channels and where all the lesions showed low resistance arterial flow (Bhat *et al.* 2014). In the present only, one lesion showed phleboliths which according to Koeller *et al.* (1999) along with the soft tissue component is a pathognomic feature of hemangiomas.

On CT hemangiomas appear as Well-defined, lobulated, iso-/hypodense lesion with enhancement and Normal or mildly enlarged feeding arteries or draining veins (Bhat *et al.* 2014).

### **Epidermoid cyst**

It has been observed in previous studies that Dermoid cysts are more common than epidermoid cysts. However, in the present study the frequency of epidermoid cysts is more than the Dermoid cysts.

Study (Koeller *et al.* 1999; Howell, 1985) showed that most of the epidermoid cysts were seen in first decade but present study shows since birth also.

There was no gender predilection (Howell, 1985). In the present study, the lesions were equally distributed in suprahyoid and infrahyoid locations. The most common location in neck was floor of the mouth (Koeller *et al.* 1999).

In CT Most of the epidermoid cysts showed homogenous fluid attenuation and also peripheral wall enhancement in case cysts were infected (Koeller *et al.* 1999).

Epidermoid cysts have homogenous fluid signal intensity that is hypointense on T1 and hyperintense on T2 weighted imaging in MRI (Howell, 1985).

### **Dermoid Cyst**

Most common age group for dermoid cysts is 2<sup>nd</sup> and 3<sup>rd</sup> decade with no gender predilection A one lesion was in floor of the mouth and the other was in infrahyoid region extending into suprasternal region and also revealed that the second most common location for dermoid cyst is floor of the mouth after lateral orbit which is the most common location for dermoid cyst in head and neck (Koeller *et al.* 1999).

In the present study, Both the lesions were in midline, thin

walled and were larger than 3 cm. 1991 in his study of 6 pathologically proven dermoid cysts observed that 5 out of 6 lesions were unilocular, heterogenous with coarse internal echoes on sonography and 3 out of 6 lesions showed posterior acoustic enhancement (Yasumoto *et al.* 1991).

In present study dermoid cyst was well circumscribed, unilocular, heterogenous with internal fat attenuating areas on CT (Mittal *et al.* 2012 (Fig. 4).

## BRANCHIAL CLEFT CYST

### 1<sup>st</sup> Branchial Cleft Cysts

1<sup>st</sup> branchial cleft cysts are very uncommon lesions which can occur in children or adults. In the present study, the age of presentation for the lesion is 13 years. Study by showed that the 1st branchial cleft usually presents as a well circumscribed cystic lesion superficial or deep to parotid gland which can have variable wall thickness and wall enhancement based on recurrent infections (Koeller *et al.* 1999).

In CT the lesion was unilocular, well circumscribed showed homogenous fluid attenuation and there was no wall enhancement (Ashok *et al.* 2016).

### 2<sup>nd</sup> Branchial Cleft Cyst

2<sup>nd</sup> branchial cleft cyst was the most common of all branchial cysts which presented between 10-40 years and there was no gender predilection. In the present study one lesion was presented at the age of 8 years and the other was at the age of 14 years and there was no gender predilection (Koeller *et al.* 1999) described 4 subtypes of 2<sup>nd</sup> branchial cleft cyst among which subtype 2 was the most common (Ashok *et al.* 2016).

The type 3 cysts extend medially between the bifurcation of the internal and external carotid arteries, lateral to the pharyngeal wall (Ashok *et al.* 2016). On sonography the lesion was well described, unilocular, thin walled and was hypoechoic with homogenous internal debris. The lesion showed posterior acoustic enhancement and showed no internal vascularity (Yasumoto *et al.* 1991) (Fig. 5).

### Ectopic thyroid

In the present study, the ectopic thyroid tissue occurred at 3 locations – base of the tongue (lingual), at the level of hyoid bone and at infrahyoid midline location. On Sonography

only two of the 3 lesions were visualized wherein they were well circumscribed with heterogenous echotexture and showed diffuse increase in internal vascularity on Colour Doppler study.

In the present study on NCCT, ectopic thyroid tissues demonstrated mildly increased attenuation and on CECT, ectopic thyroid tissues appeared as well-circumscribed homogeneous avidly enhancing lesions.

## CONCLUSION

The present study was done on 38 pediatric patients having congenital or developmental neck mass lesions. They were evaluated on Ultrasonography and Colour Doppler Flow study among which some of them underwent CT and MRI.

The most common neck mass lesion in present study was cystic hygroma 28.9% followed by thyroglossal duct cyst (18.4%) and lymphovenous malformation (15.8%). Various neck lesions have varied presentation.

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