Imaging neck masses in children - a pictorial review with focus on ultrasound

Poster No.: C-3156
Congress: ECR 2018
Type: Educational Exhibit
Authors: C. Asavoaie¹, M. Cosarca¹, A. C. ANDREI², C. Lazea², R. Popa¹, C. Szabo¹, O. Fufezan¹; ¹Cluj-Napoca/RO, ²CLUJ NAPOCA/RO
Keywords: Hemangioma, Congenital, Abscess, Biopsy, Ultrasound, MR, CT, Pediatric, Lymph nodes, Head and neck
DOI: 10.1594/ecr2018/C-3156

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

• To illustrate the ultrasound (US) features of the most frequently encountered pediatric neck masses (inflammatory lymph-nodes, parotitis, hemangiomas, lymphangiomas, fibromatosis colli, branchial cleft and thyroglossal cysts, abscesses, lymphoma) as well as some of the rare causes of neck swelling in children (myositis, histiocytosis, ectopic thyroid or thymus, neurofibroma, teratoma).

• To present a diagnostic approach for pediatric neck masses with focus on ultrasound as the first line imaging tool.
Background

Neck swelling in children represents a very frequent cause for presentation in pediatric units. They may be congenital and acquired, inflammatory or tumoral, benign or malignant and they can arise from any neck structures such as the common lymph-nodes, the salivary glands, thyroid, thymus, muscles, vascular structures and bones.

With these pathological and anatomical heterogeneity it may truly be a challenge to reach a diagnosis and decide on the proper treatment and therefore imaging is often required.

The first line of imaging is obviously represented by US since it is widely available, it is accepted by children and parents and in many cases it is sufficient for diagnosis, thus avoiding other more invasive procedures.

Magnetic resonance (MR) is required in the case of larger lesions in order to demonstrate their extent and the involvement of the deep structures of the neck.

Computed tomography (CT) is sometimes performed in emergency when there are large neck abscesses, but it should be avoided whenever possible in children.
Findings and procedure details

US is the method of choice when approaching pediatric neck masses and therefore this presentation will focus on the US examination and when necessary will make reference to MR or CT.

US examination technique

- The patient is examined in a supine position with a pillow or the hand of the mother placed under the shoulders of the child in order to obtain proper head extension.
- Since the targeted lesions are mainly superficial, the examination is routinely performed with a linear transducer (7-14 MHz) to ensure a detailed visualization and characterization of the neck structures and encountered lesions.
- When large lesions are encountered a curvilinear transducer may also be used to appreciate their margins, exact location and relationship with neighboring structures. Yet in these situations further imaging is required.

US Anatomy of the neck

Some of the neck lesions are space specific, while others may arise in various areas of the neck. Still, a solid knowledge and understanding of the neck anatomy is mandatory for the evaluation of neck masses, both for diagnosis as well as for appreciating extension and accurate localization. (Fig. 1)

Neck masses classifications

Due to their heterogeneity neck masses may be subdivided in various ways: upon their cystic or solid nature, age at presentation, etiology or anatomic location. None of these classifications is better than the other and actually all of the criteria are to be considered when making a diagnosis. (Table I)

CYSTIC LESIONS

1. Thyroglossal duct cyst

Thyroglossal duct cysts are very common among pediatric patients. They arise on the anterior midline of the neck and may be found anywhere along the thyreoglossal duct which extends from the base of the tongue to the foramen caecum of the thyroid.
**US findings:** they appear as round/oval fluid-filled lesions. Depending on the content they may be anechoic, hypoechoic or with internal echoes if hemorrhage or infection occurred. (Fig. 2, 3, 4)

2. **Dermoid cyst** is a broad term which usually includes epidermoid cysts, dermoid cysts and teratomas. These are usually a rare cause for swelling of the neck, but must be taken into consideration in the differential diagnosis. They are located close to the hyoid bone, close to the midline, sometimes in the mouth floor.

**US findings:** well-circumscribed oval shape lesion, variable internal echogenicity, depending on the fat content, with acoustic shadowing and sometimes calcifications.

3. **Brachial cleft cysts** represent embryological developmental alterations of one of the four branchial arches, their incomplete obliteration causing the formation of cysts (most cases), sinuses or fistulas.

Most of these lesions are remnants of the second branchial cleft, often found in the submandibular area, but also in the anterior triangle of the neck, close to the anterior margin of the sternocleidomastoid muscle. Cysts encountered at the level of the thyroid gland represent remnants of the third or fourth brachial arch.

**US aspect:** hypoechoic, fluid filled cystic mass, with internal echoes (cholesterol crystals), usually homogeneous, causing acoustic shadowing. Yet, sometimes they may appear inhomogeneous if septations develop or if complications occur (infection, hemorrhage). Fig. 6

4. **Ranulas** represents a fluid-filled lesion, caused by the obstruction of the sublingual salivary gland.

**US findings:** submental or submandibular anechoic mass in relationship with the sublingual gland. (Fig. 7)

**PARENCHIMAL LESIONS**

1. **Inflammatory lymph nodes**

Reactive inflammatory lymph nodes represent a response to the infection or inflammation of the neighboring structures (salivary glands, tonsils, teeth, ear etc)

**US findings:** normally lymph nodes are oval, hypoechoic with an echoic center. When infection or inflammation occurs they become slightly enlarged, more hypoechoic than normal and have a broader echogenic center.(Fig. 8)
2. **Lymphadenitis** is an infection of the lymph-node itself, either bacterial or viral (frequently *Staphylococcus aureus* or *B-hemolytic Streptococcus*). The lymphnodes are swollen, painful at palpation and the suprajacent skin becomes warm and red.

**US findings:** lymph nodes become enlarged, with small hypoechoic areas (liquefaction) and inflammation of the surrounding fat. (Fig. 9, 10)

3. **Lymph node abscess**

Abscess formation within a lymph node is difficult to diagnose only by clinical evaluation and therefore imaging is necessary.

**US findings:** hypoechoic central areas of fluid surrounded by a wall or collections with floating echo-reflections are suggestive for abscess formation. (Fig. 11) Even though these features are rather specific, according to literature US is not entirely reliable in imaging abscess and sometimes further imaging is required in order to accurately determine the size of the abscess and its effect on the other neck structures (MR, CT).

4. **Lymphoma** often presents as a painless, large lymphadenopathy, cervical nodes being most commonly associated with Hodgkin lymphoma.

On ultrasound the affected nodes are round, homogeneously hypoechoic and the normal echogenic hilum is absent.

**US findings:** large, numerous, well-circumscribed, rounded nodes with reduced echogenicity, altered vascularity and an absent hilum. These findings are not specific for lymphoma and therefore biopsy and histology are mandatory. (Fig. 12, 13, 14) Further imaging (MR, PET-CT) are required to determine extension of the disease.

**Salivary glands**

Pathology of the salivary glands includes mainly infections (viral or bacterial), parotid hemangiomas, autoimmune and granulomatous diseases, lithiasis, tumors (rare)

5. **Parotitis** - can be either bacterial or viral, acute or chronic, uni- or bilateral.

**US findings:** the gland becomes larger, inhomogeneous (with small hypoechoic areas inside), increased vascularity and reactive lymphnodes inside. (Fig. 15, 16)
Thyroid lesions among pediatric patients include congenital lesions (such as aplasia/hypoplasia or ectopic thyroid), inflammatory (thyroiditis) and neoplastic lesions. (Fig. 17, 18, 19, 20, 21)

6. Thyroiditis (Hashimoto and Basedow-Graves disease)

In both Hashimoto’s thyroiditis and Basedow-Graves disease may present with an enlarged, palpable thyroid gland.

Hashimoto’s thyroiditis is an autoimmune disease associated mainly with hypothyroidism. **US findings:** include an enlarged gland, with a very inhomogeneous, nodular structure, sometimes with increased vascularity (but vascularity may be normal) (Fig. 22, 23). In the course of the disease the gland gets smaller in size, develops internal echoic, fibrotic septations.

In Basedow-Graves disease the thyroid gland is even more enlarged and the vascularity is extremely increased (Fig. 24). The Color Doppler appearance in Basedow has been described as a red-blue inferno. (Fig. 25)

7. Thyroid cysts and nodules - are very common and can be either single or multiple, purely cystic or solid and sometimes complex.

**US findings:**

On ultrasound thyroid cysts can be anechoic, sometimes with bright internal spots (colloid cysts) or hypoechoic with acoustic shadowing.

Thyroid nodules are usually isoechoic compared to the normal gland.

When evaluating the thyroid nodules one must be aware of signs of malignancy: nodules that increase in size, hypoechogenicity, calcifications, complex lesions (cysts with mural nodules), altered vascularity, enlarged lymphnodes.

Papillary carcinoma is the most frequent thyroid malignancy and has usually a favorable prognosis. (Fig. 26, 27)

8. Myositis

The neck is an area with multiple muscles which may cause neck swelling. Sometimes it is a pathology of the muscle itself (inflammatory, autoimmune, traumatic, tumoral) while sometimes they are affected by lesions of surrounding structures.
**US findings:** In myositis the normal, fibrillar structure of the muscles is lost and becomes inhomogeneous, with increased vascularity and sometimes fluid collections (abscess) or calcifications. (Fig. 28, 29, 30, 31)

10. **Fibromatosis colli** is another muscular lesion which is found in newborns (about three weeks after birth). It presents as swelling of the sternocleidomastoid muscle, usually associated with torticollis.

It is believed to be caused by the muscle trauma (pressure necrosis) during birth.

**US findings:** On US the affected sternocleidomastoid muscle is swollen, fusiform in the mid portion and the normal structure is altered. It may appear hypo or hyperechoic and one or both heads of the muscle may be involved.

Usually the swelling regresses by itself in a few months. (Fig. 32, 33)

9. **Pilomatrixomas** are benign skin inclusion cysts associated with hair follicles. They are firm, mobile and painless and develop mainly in the neck area.

**US findings:** Oval, hyperechoic lesions, sometimes with internal calcifications, acoustic shadowing and wall vascularity present. (Fig. 34)

11. **Neurofibromas** are benign neurogenic tumors that develop from nerve sheaths and are most often associated with Type I Neurofibromatosis. They grow slowly along nerves path and appear as elongated parenchymal lesions. (Fig. 35, 36, 37)

**Bone lesions**

13. **Langerhans cell histiocytosis**

The bones are the most affected by histiocytosis with the skull being most frequently involved, but also the mandible. That is why a mass in the mandibular area which causes bone destruction must include this diagnosis in its differential. (Fig. 38, 39, 40, 41)

Other bone lesions such as osteomyelitis or bone tumors must also be considered in the differential, but in this cases further imaging is necessary (X-ray, MR or CT).

**Vascular lesions**

Congenital vascular malformations are frequently found in the head and neck area. They can be broadly divided into: infantile hemangiomas and vascular malformations (lymphangiomas). Fig. 42, 43, 44.
**Lymphangiomas** - are congenital lymphatic malformation caused by an abnormal development of the lymph vessels. They are most often found in young children and up to 90% of them occur in the head and neck area.

When found within the posterior triangle of the neck they appear either as one or more large cysts (most frequently) and when found anteriorly as small, numerous cysts, sometimes infiltrating the deeper structures of the neck.

Cystic hygromas can sometimes be very large, affecting various spaces of the neck and causing mass effect on the neck structures. In these situations further imaging is often required (MR, CT)

**US findings**: poorly delineated, complex cystic lesion, with numerous internal septations, anechoic when uncomplicated or inhomogeneous if hemorrhage occurs.

Doppler interrogation may show vascularity at the level of the internal stroma.
**Table 1: Classification of pediatric neck masses**

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 1:** Cystic neck masses

Fig. 2: Thyroglossal duct cyst

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 3:** Infected thyroglossal duct cyst with fistula

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO

**Fig. 4:** Infected thyroglossal duct cyst

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 5: Dermoid Cyst

Fig. 6: Branchial Cyst

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 7: Ranula

**Fig. 8:** Reactive lymph nodes

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 9: Lymphadenitis - oval, enlarged, hypoechoic, inhomogeneous cervical lymph node

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 10:** Lymphadenitis - increased vascularity on Power Doppler

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 11:** Lymph node abscess - fluid filled lesion on the anterior border of the sternocleidomastoid, with hypoechoic content and echoic walls. There are other reactive lymph nodes caudal to the lesion and the muscle is enlarged and its structure is altered.

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 12: Lymphoma - multiple, round, hypoechoic, enlarged cervical lymph nodes, with no hilum. Histology confirmed Hodgkin lymphoma.

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 13: Enlarged lymphnode with altered vascularity (same patient as previous image).

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 14:** Lymphoma - coronal T2W

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 15: Viral parotitis - gland is enlarged and inhomogeneous

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 16: Viral parotitis - increased vascularity

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO

Fig. 17: Thyroid agenesia in newborn with altered levels of TSH
Fig. 18: Thyroid hypoplasia/dysplasia (no normal thyroid tissue in the thyroid area) in a 14 years old male with normal intelligence, but growing deficiency
Fig. 19: Thyroid hypoplasia/dysplasia (no normal thyroid tissue in the thyroid area) in a 14 years old male with normal intelligence, but growing deficiency. Ectopic thyroid was visualised on the midline, along the path of the thyroglossal duct.

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 20:** Ectopic thyroid - increased vascularity (same patient as Fig. 18, 19)

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 21:** Ectopic thyroid - MRI aspect (same patient as Fig. 18, 19, 20)

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 22: Hashimoto’s thyroiditis - enlarged gland, inhomogeneous structure

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO

Fig. 23: Hashimoto’s thyroiditis - enlarged gland, inhomogeneous structure, increased vascularity
Fig. 24: Basedow-Graves Disease - very enlarged, hypoechoic gland, slightly inhomogeneous structure
**Fig. 25:** Basedow-Graves Disease - enlarged, hypoechoic gland, slightly inhomogeneous structure, thyroid "inferno" (extreme hypervascularity)

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO

**Fig. 26:** Papillary thyroid carcinoma in a 14 years old girl - cystic lesion with echoic, mural nodule

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 27: Papillary thyroid carcinoma in a 14 years old girl - cystic lesion with echoic, vascular, mural nodule - diagnosis was confirmed histologically after excision

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 28: Sternocleidomastoid myositis - B mode

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 29:** Sternocleidomastoid myositis - increased vascularity

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO

**Fig. 30:** Lymphnode abscess with sternocleidomastoid myositis and abscess formation (coronal T2W)

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 31: Lymphnode abscess with sternocleidomastoid myositis and abscess formation (axial T2W)

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 32:** Fibromatosis colli in four weeks old male - enlarged, fusiform sternocleidomastoid muscle

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO

**Fig. 33:** Normal sternocleidomastoid muscle - same patient as Fig. 22 - contralateral side

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 34:** Pilomatrixoma


**Fig. 35:** Neurofibroma - hypoechoic, homogeneous lesion caudal from the right thyroid lobe in 5 years old girl with Type I Neurofibromatosis

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 36: Neurofibroma - hypoechoic, homogeneous lesion caudal from the right thyroid lobe in 5 years old girl with Type I Neurofibromatosis. The aspect in the long axis suggests the relationship with the vertebral bodies.

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 37: Neurofibroma - MRI aspect (same patient as Fig 35, 36)

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Fig. 38: Large angulomandibular lesion in 2 years old male, hypoechoic, inhomogeneous - Langerhans cell histiocytosis (histological diagnosis after biopsy).

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 39:** Large angulomandibular lesion in 2 years old male, hypoechoic, inhomogeneous, with internal vascularity (same patient as Fig. 34) - Langerhans cell histiocytosis

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 40:** Bone destruction - mandible line is disrupted by the lesion. Large angulomandibular lesion in 2 years old male, hypoechoic, inhomogeneous, with internal vascularity (same patient as Fig. 34, 35) - Langerhans cell histiocytosis

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 41:** Langerhans cell histiocytosis of the left mandible - MRI aspect

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 42:** Hemangioma - B mode and Color Doppler

Fig. 43: Large lymphangioma infiltrating deep structures of the head and neck. (T2w)

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
**Fig. 44:** Large lymphangioma with mass effect and infiltrating deep structures of the head and neck.

© Radiology, Emergency Children Hospital, Cluj-Napoca - Cluj-Napoca/RO
Conclusion

Ultrasonography represents the first-line examination due to its excellent visualization and characterization of neck structures, availability and lack of radiation. It is able to establish the parenchymal or cystic nature of a mass and its vascularity pattern.

In certain situation, mainly due to the large size of some lesions, magnetic resonance (MRI) or computed tomography (CT) are necessary in order to establish the origin of a mass or its extent. MRI is preferred due to its superior conspicuity and delineation of lesions and anatomical structures and also lack of radiation.
References


https://radiopaedia.org/articles/langerhans-cell-histiocytosis-skeletal-manifestations-1