The value of Computed Tomography in pediatric neck diseases at the emergency department

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Learning objectives

The authors provide a pictorial review of the computed tomography (CT) findings of the most common pediatric neck disorders at the emergency department, emphasizing its added value when compared to conventional radiography, ultrasonography (US), and magnetic resonance imaging (MRI). This manuscript aims to answer some of the most frequent questions that clinicians and radiologists face on daily practice:

1. When does US suffice for the diagnosis?
2. Which conditions should lead to prompt CT evaluation notwithstanding the ionizing radiation exposure risks?
3. How to reduce CT dose exposure?
4. Are there categorical indications for performing MRI at the emergency department?
5. When should complementary CT or MRI be postponed and electively performed?
Background

Pediatric neck emergencies comprise a wide range of diseases, including inflammatory, infectious, congenital, vascular, traumatic, and neoplastic conditions. The clinical history and physical examination are often limited and non-specific, therefore imaging evaluation is frequently required. Furthermore, some disorders involve or extend into the deep cervical spaces, consequently leading to life threatening complications like airway obstruction or mediastinitis.

The diagnostic imaging modality should be primarily chosen according to the patient's clinical status. Radiography, US, and CT are the most commonly used techniques in the initial approach of neck diseases at the emergency department. In regard to CT, ionizing radiation exposure, intravenous administration of iodinated contrast, and the eventual need of sedation or anesthesia are matters of concern for both clinicians and radiologists. MRI is seldom used at the emergency setting, but may be indicated for depicting lesions extent in complex cases, and in some specific conditions like spondylodiscitis, osteomyelitis, septic arthritis, and spinal cord lesion.
Findings and procedure details

Ultrasound

US has been consensually regarded as the first imaging modality for investigation of pediatric neck masses in the emergency setting. This is a fast and readily available technique that does not imply radiation exposure and sedation (1). However, US is operator dependent and limited in the evaluation of deep cervical lesions, especially when located in the midline. On the other hand, the placement of the probe on the child's neck is frequently painful or uncomfortable, leading to patient refusal and motion (2).

In regard to the role of US in the detection of cervical abscesses, some studies have been performed, but the results are variable and apparently non-consensual. Douglas et al (3) attempted to determine the accuracy of US in detecting the presence of pus in a neck mass in children, reporting a relatively low sensitivity level (65%). In other study, Mallorie et al (4) showed sensitivity and specificity levels of 96% and 82% for US in distinguishing purulent collections from non-purulent swelling, respectively.

In the pediatric setting, US is particularly accurate in assessing lymph nodes, salivary glands disorders (Fig. 1), branchial cleft cysts (Fig. 2), thyroid lesions, and thyroglossal duct cysts (Fig. 3, 4).

In children, viral infections are the most common cause of salivary gland disorders. Despite non-specific, US findings are typical and highly suggestive in patients with fever and unilateral or bilateral neck swelling. Parotiditis due to mumps virus and cytomegalovirus is particularly frequent at the emergency department. The parotid gland typically appears enlarged and heterogeneous, with increased blood flow and multiple small, oval, hypoechoic areas (Fig. 1). Bacterial infections, despite less common, are more prone to form abscesses and extend to the parapharyngeal space. In these cases, CT and MRI may be required, since deep lobe changes are not easily depicted at the US and the acoustic shadow of the mandible may hide deep lesion extension (5,6).

The second branchial cleft cyst is the most common branchial cleft abnormality. US usually identifies a cystic lesion placed anteromedial to the sternocleidomastoid muscle, anterolateral to the carotid arteries, and posterior to the submandibular gland (Fig. 2). CT and MRI may be required to clarify doubtful cases or precisely depict anatomy before surgery (6-9).
Due to its superficial topography, US easily evaluates the thyroid gland. Hashimoto's disease is the most frequent thyroid pathology in children, but not usually diagnosed at the emergency department. However, the thyroid gland may appear enlarged and palpable, thus alarming parents. US may also show a coarsely hypoechoic parenchyma. Acute hyperthyroidism due to Graves' disease is less common and, despite the parenchyma is typically homogeneous, the gland may be enlarged and hypervascular (7).

Thyroglossal duct cysts may appear all along the anatomic course of the embryologic thyroid primordium, from the foramen cecum to the level of the hyoid bone. However, most thyroglossal duct cysts are closely associated with the hyoid bone, usually within 2 cm of the midline. The diagnosis may be clinical, but imaging is frequently required. US easily recognizes infra-hyoid cysts due to its superficial and accessible topography (Fig. 3). Above the hyoid bone, thyroglossal cysts become deeper and more difficult to diagnose at US (Fig. 4). Even when the diagnosis offers no doubt, preoperative imaging with CT or MRI may be performed to better depict its extension, identify ectopic thyroid tissue, and exclude malignancy within the cyst (6,8-10).

Less common congenital cysts like dermoid, epidermoid, thymic, bronchogenic, laryngeal, esophageal duplication cysts, and those which derive from the first, third and forth branchial clefts, may be similarly detected (6,11).

Other lesions like lymphangiomas, haemangiomhas, venous malformations, and arteriovenous malformations are less commonly found at the emergency department. Acute complications like hemorrhage and infection may occur but seldom constitute the first manifestation. Color and/or Power Doppler US may be used in the initial approach, guiding clinicians towards the most suitable diagnosis. However, these lesions are frequently ill-defined or trans-spatial and further imaging is required for evaluating its extent and anatomical relationships for surgical planning. MRI is the most accurate modality in this setting and may be electively performed (7,8).

**Computed Tomography**

In general, CT should be considered a second-line method for evaluating emergency neck diseases. An initial US evaluation suffices in many cases, and may be posteriorly complemented with CT in doubtful conditions. However, some severe presentations that imply emergent surgical approach and otolaryngology consultation may be candidates for initial CT evaluation (1). Reasonable justification and consideration of side effects to the child are vital. Long-term effects of ionizing radiation exposure are not negligible and constitute the most concerning point (2).
The absorption of ionizing radiation is significantly superior in tissues with high cell turnover. Consequently, children's overall sensitivity to radiation is up to 10 times higher than in adults. Some authors consider that 1 among 1000 children will die due to cancer after a single non-optimized head CT (12). Consequently, some technical features should be considered while performing a CT in children. First of all, clinical criteria should be rigorously analyzed in order to eliminate inappropriate referrals and avoid unwarranted neck CT examinations that would lead to unnecessary irradiation of the thyroid gland (13).

The ALARA principle ("As Low As Reasonably Achievable") should always be respected (12). Age, size, and clinical status should also be considered to adjust the dose. Both physicians and radiologists should be familiarized with technical procedures and parameters that allow dose reduction:

- Patient immobilization or sedation may be required to avoid motion artifacts and repeated scans (13);
- Tight scout-views should be acquired (12);
- Scan length must be optimized according to the clinical inquiry (12);
- Multiphase scans must be avoided (12,13);
- Dose parameters like kV and mAs should be adapted (12);
- Patient should be precisely centered in the gantry, essentially if an automatic tube current modulation is used. It uses localizer images to adjust the mAs according to the patient anatomy (13);
- Avoiding low pitch values is desirable. Applying pitch values lower than one, the radiation dose increases since the beam overlaps previously radiated tissue at each rotation (13);
- Computed Tomography Dose Index (CTDI), Dose Length Product (DLP), or other dose estimation parameters should be routinely checked and compared with national and international reference values (12).

Intravenous administration of iodinated contrast media is frequently necessary in neck CT studies. Particularly in newborns, the administration of intravenous contrast material should be avoided and carefully selected due to kidney immaturity. The administered volume should also be age adjusted (12). The main roles of CT in the approach of pediatric neck disorders at the emergency department may be listed as follows:

1. Depict the exact location and extension of a US-identified lesion;
2. Identify potentially drainable abscesses;
3. Identify foreign bodies;
4. Evaluate bone and cartilaginous structures;
5. Detect severe infections and life-threatening conditions.

Location and Extension

Radiologists should be able to realize when US is insufficient to localize and characterize a neck disorder. Some superficially palpable lesions may extend to deep cervical spaces.
and lead to potential life-threatening complications. Furthermore, superficial lymph node enlargement is a common, non-specific and usually transient finding, but may result from severe, deep non-accessible infections. Consequently, CT is often required to determine the extent of a lesion and better define its tissue characteristics and surrounding anatomy (Fig. 6, 7, 8) (1). This prior knowledge helps surgeons to perform deep neck infections or abscesses drainages safely, without damaging vital structures.

**Phlegmon and Abscesses**

Confronted with the scarcity of studies comparing the accuracy of CT and US in pediatric patients with neck abscesses, Collins et al (2) compared the accuracy of these two imaging techniques using incision and drainage of the suspected abscess as the gold standard. 140 imaging studies (39 US and 101 CT examinations) performed in patients ranging from 0 to 18 years were included. The authors concluded that US is equivalently sensitive and more specific than CT in the work-up of lateral neck abscesses in children. However, these results are not consensual. In other study by Lee et al (1), predictive positive value of CT in the detection of deep neck infections, salivary gland infections, and tonsillitis was 100%, and the correlation between clinical impression and CT findings was moderate (78%) in regard to deep neck infections and abscesses. A prior study by Lazor et al (14) had already reported high sensitivity (88%) of CT for detection of parapharyngeal or retropharyngeal space abscesses. One of the main roles of CT is thus to distinguish a phlegmon from an abscess. This distinction is commonly required for tonsillitis and deep cervical space infections. While a phlegmon lacks a ring enhancement or shows only partial peripheral enhancement, an abscess typically presents with a thick, irregular, enhancing wall (9).

The diagnosis of acute tonsillitis is essentially clinical. The role of imaging is to help differentiate non-complicated tonsillitis from a peritonsillar abscess, which arise between the tonsillar capsule and pillar (Fig. 9). US examination is frequently inconclusive due to impaired acoustic window; therefore, contrast-enhanced CT may be required. However, even with contrast-enhanced CT, the differentiation of a peritonsillar abscess from a suppurative retropharyngeal lymph node may be challenging. If extension into the deep spaces of the neck like the parapharyngeal and retropharyngeal spaces is suspected, CT should be the first choice (9,15,16).

The incidence of deep space neck infections (DNI) in children has increased over the last years, but epidemiological data regarding this issue is scarce. Earlier diagnosis and the increasing incidence of drug-resistant oropharyngeal bacteria appear to be important contributors. Particular concern derives from methicillin-resistant *Staphylococcus aureus* (MRSA) (17,18).
Retropharyngeal space infection is more common in children under 6 years (19). A study of Novis et al (17) showed a significantly lower average age for retropharyngeal abscesses (5.0 years) in comparison to peritonsillar or parapharyngeal abscess (13.6 and 6.6 years, respectively). It is usually related to suppuration of retropharyngeal lymph nodes, usually secondary to infection in the nasopharynx, oropharynx, or paranasal sinuses (9,16). Other causes like pharyngeal or esophageal perforation are less common (18). US may demonstrate hypoechogenic areas in the retropharyngeal space but can not exactly depict the extent of the disease. Variable-sized enlarged lymph nodes may be found either in retropharyngeal space or in more superficial spaces (18). CT scans usually show mild-to-severe fat stranding and linear hypodense fluid with variable degrees of thickness (Fig. 10, 11, 12). It should be emphasized that retropharyngeal abscesses may lack the typical ring-enhancement (6,16).

Most masticator space infections are odontogenic, commonly resulting from periodontal disease at the posterior mandibular molars. Dental caries are the initial event in most odontogenic infections. Bacteria enter the tooth and spread to the apex, leading to apical periodontitis, granuloma, abscess and eventual radicular cyst formation. CT evaluates both the underlying dental disease and the soft tissue component (Fig. 13). CT images in bone window setting allow the visualization of periodontal lucencies and cortical fistulas. Contrast-enhanced images in soft tissue window settings may recognize extra-radicular and extra-osseous abscesses as fluid collection with rim-like enhancement, and depict the exact extent of the infection. Masticator space infections may extend medially and inferiorly to the sublingual and submandibular spaces, laterally and posteriorly to the parotid space, and medially to the parapharyngeal space. Superior extension to the temporal fossa may be seen in aggressive infections. Mandibular osteomyelitis is a potential complication, but difficult to identify on early CT scans. MRI is more accurate for detecting early bone marrow changes and is now considered a first-line modality when osteomyelitis is suspected. The surgical approach of masticator space infections, either intraoral or external, depends on CT findings (9,15,16).

The Ludwig angina is a severe, necrotizing infection that comprises the floor of the mouth and both submandibular spaces. It mostly results from odontogenic infections involving the second and third mandibular molars. The role of CT is similar to that describe above for masticator space infections (9,16).

**Foreign Bodies**

The aspiration of foreign bodies is usually found in children between the ages of 1 and 3 years. The aspirated object is more likely to be found at the right main stem bronchus, and seldom becomes lodged in the upper airway (Fig. 14). Anteroposterior and lateral neck and chest radiographs should be obtained in stable patients. CT may help localizing the foreign body in doubtful cases. In clinically instable patients, immediate laryngoscopy
or bronchoscopy may be needed. The majority of the aspirated objects is radiolucent, thus it is not uncommon to obtain inconclusive radiographs. Radiologists should also look for indirect signs like air trapping and post-expiration hyperinflation (9).

Ingested foreign bodies may be found either in the hypopharynx or in the esophagus. The cricopharyngeus muscle, the aortic arch esophageal impression, and the lower esophageal sphincter are the most common lodge sites. Radiography should be the primary modality for imaging evaluation. In contrast to aspirated foreign bodies, ingested objects like coins and food are more likely to be radiopaque. CT is indicated in doubtful cases, instable patients, and when perforation or deep cervical spaces involvement are suspected (9).

**Bone and Cartilage**

CT remains the best imaging modality for cortical bone evaluation. In the emergency setting, trauma constitutes the main indication and no further imaging is usually required, unless spinal cord or cranial nerve injuries are suspected. In these cases, MRI is significantly more accurate. CT is not only indicated for depiction and pre-surgical planning of bone fractures, but also in the evaluation of laryngeal trauma. CT is able to recognize most cartilaginous fractures and should be considered the first-line modality in this setting. MRI is a second-line choice and may be useful in the assessment of epiglottic avulsion and fractures that involve non-ossified cartilages (20).

In the acute bone infection setting, CT is less accurate than MRI. Bone marrow evaluation is suboptimal, and early osteomyelitis is frequently non-detected. CT is thus more useful for depiction of chronic changes like cortical thickening and sequestrum. In regard to cervical spondylodiscitis, CT is able to depict cortical destruction of the vertebral bodies, prevertebral abscesses, and posterior epidural enhancement. However, MRI is much more sensitive and should be used as the first-line imaging tool even at the emergency department (Fig. 16).

Besides bone evaluation, CT is accurate for detecting soft-tissue calcifications. Calcific tendonitis of the longus coli muscle is the classic example. CT has been the preferred diagnostic imaging modality, showing amorphous calcifications in the prevertebral space. On MRI, calcifications appear as signal voids but may be difficult to recognize. On the other hand, MRI is superior to CT in the recognition of surrounding edema. Paravertebral and intervertebral disk calcifications are also better depicted on CT scans (Fig. 17).

**Severe Infections and Life-threatening Conditions**
The great majority of pediatric deep cervical infections respond positively to intravenous antibiotics and surgical drainage. Complications like mediastinitis, jugular vein thrombosis, and airway obstruction are rare, but its severity and life-threatening potential imply high clinical care (17). CT is essential to exclude life-threatening complications and evaluate the exact extent of deep neck infections at the emergency department, thus helping surgeons to decide whether an urgent surgical intervention is mandatory or not. CT reports should provide information regarding the following features:

- Airway compromise (Fig. 12);
- Vascular complications;
- Descending infection into the mediastinum;
- Abscess size and trans-spatial extension (Fig. 6, 12);
- Involvement of critical spaces like retropharyngeal (Fig. 6, 10, 11, 12, and 15), prevertebral (Fig. 16), visceral or carotid spaces (16).

Septic jugular vein thrombophlebitis secondary to oropharyngeal infections is an uncommon life-threatening condition, also known as Lemierre syndrome. It is more common in teenagers than in infants and children. *Fusobacterium necrophorum*, an anaerobic gram-negative bacillus, is the most common pathological agent. Imaging evaluation is mandatory, and contrast-enhanced CT is the modality of choice. It enables the visualization of a hypodense intraluminal filling defect representing a thrombus, and simultaneously depicts surrounding deep spaces involvement (6,15).

The retropharyngeal space is the most common route by which neck infections achieve the posterior mediastinum. It happens when the alar fascia is eroded by the retropharyngeal infection and penetrates into the danger space. This space extends from the skull base to the posterior mediastinum, between the alar and prevertebral fasciae (6,16,17).

### Magnetic Resonance Imaging

In the emergency setting, MRI is seldom required due to its increased imaging time and frequent need of sedation. However, it should be the first-choice modality when osteomyelitis, spondylodiscitis (Fig. 16), septic arthritis, and spinal cord lesion are suspected.

Conventional radiography and three-phase bone scintigraphy were traditionally used in the diagnostic imaging of pediatric osteomyelitis. According to some authors, if bone rarefaction and periosteal reaction are found on conventional radiography, further imaging may be postponed. However, this is a general rule that may be applied in cases of long bone infection but never when cervical spondylodiskitis is suspected (21). Moreover, conventional radiography is insensitive for identification of acute osteomyelitis (22).
Bone scintigraphy is highly sensitive and may detect multiple sites of infection. It is particularly useful when the site of osteomyelitis is not clinically evident (23). However, this technique is limited in depicting local extension and discriminating between bone and soft-tissue infection. Since both spondylodiskitis and jaw infections may result from or lead to deep cervical infections, this distinction is mandatory. Therefore, CT and MRI are frequently required (21). CT is particularly useful in the detection of chronic features like sequestrum, cortical thickening and fistulae. However, it cannot accurately detect acute bone marrow infection and is less accurate than MRI in the detection of epidural space involvement (21). US is relatively suitable for assessing soft-tissue changes but is suboptimal for bone evaluation (23). Over the last decades, MRI has been increasingly required for bone infection depiction and is now considered the most accurate imaging technique. Short-tau inversion recovery (STIR) and fat-suppressed contrast-enhanced T1-weighted sequences are the most accurate. MRI is much more sensitive for early disease and is able to identify infected bone marrow and surrounding edema, as well as to distinguish soft-tissue phlegmon and abscess (21,22,24). Therefore, MRI should be the modality of choice when jaw infection or cervical spondylodiskitis are suspected (15,16,22,23).

Septic facet arthritis is an unusual cause of acute neck pain that may mimic spondylodiskitis presentation. CT may identify joint effusion, periarticular edema, rim-like joint enhancement, and mixed lytic and sclerotic bone changes. MRI is more accurate for the detection of associated osteomyelitis, myositis, and epidural extension (18). Non-infectious synovitis associated to inflammatory joint diseases or facet joint transient synovitis may also present with acute neck pain and benefit from MRI evaluation (Fig. 18).

Trauma is not under the scope of this manuscript, but it should be emphasized that MRI is a first-line modality in the evaluation of trauma-related spinal cord injury, extradural spaces involvement, and the integrity of the spinal ligaments (25). In the trauma setting, MRI may also be required as a second-line approach when cranial nerve lesion is suspected but not clearly depicted on CT scans (26).
Fig. 1: Acute parotiditis in a 9-year-old boy with tender swelling at the angle of the left mandible. Longitudinal gray-scale US image shows an enlarged heterogeneous parotid gland with multiple hypoechoic nodules, representing lymph nodes (n).

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Fig. 2: Second branchial cleft cyst in a 6-year-old boy who was admitted to the emergency department with neck swelling. (A) Color Doppler US image shows a well-circumscribed, non-vascularized, hypoechoic cystic lesion with posterior enhancement. (B, C) Axial T2-weighted and sagittal short-tau inversion recovery (STIR) MR images show a simple, hyperintense cyst anteromedial to the sternocleidomastoid muscle (s) and anterolateral to the carotid arteries (white arrow). The beak sign between the sternocleidomastoid muscle and the cyst is also typical (red arrow).
Fig. 3: Infected thyroglossal duct cyst in the anterior portion of the infra-hyoid neck of a 4-year-old boy who presented to the emergency department with a 3-month palpable mass, which had recently enlarged. (A) Transverse gray-scale US image of the infra-hyoid neck shows a midline, ill-defined, hypoechoic and heterogeneous lesion (arrows) displacing the thyroid gland (t) and the trachea (T) to the left. (B) Sagittal STIR MR image depicts the cystic high-signal-intensity nature of the lesion and shows its lobulated contour and thick hypointense wall. (C) Axial contrast-enhanced T1-weighted MR image shows enhancement of the cyst wall and the strap muscles. Tracheal displacement is also seen (arrow).
Fig. 4: Thyroglossal duct cyst at the base of the tongue of a 13-year-old girl who presented to the emergency department because of dysphagia. (A) Transverse gray-scale US image of the supra-hyoid neck shows a midline, well-circumscribed, cystic lesion with posterior enhancement. (B, C) Axial and sagittal T2-weighted MR images reveal the cystic high-signal-intensity nature of the lesion and better depict its location at the base of the tongue (arrows). (D) Axial contrast-enhanced fat-suppressed T1-weighted MR image shows a round, non-enhancing hypointense lesion (arrow).

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Fig. 5: Esophageal duplication cyst in an 11-month-old boy who presented to the emergency department with neck swelling. (A) Color Doppler US image shows a huge cystic lesion with mixed echogenicity and a well-defined wall with an inner echogenic layer and an outer hypoechogenic layer, corresponding to the mucosa and muscle, respectively. (B, C) Axial and coronal T2-weighted MR images reveal a hypointense unilocular cyst close to the esophagus (arrow) in the left retrovisceral space. The carotid sheath (red arrow) and the sternocleidomastoid muscle (s) are displaced posteriorly and laterally, respectively.

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Fig. 6: Retropharyngeal abscess due to methicillin-sensible Staphylococcus aureus in a 1-year-old girl with fever and neck swelling. (A) Power Doppler US image shows a huge, left posterior, hypoechoic, non-vascularized lesion, with ill-defined deep margins. (B) Lateral CT scout-view demonstrates enlargement of the retropharyngeal space (arrow). (C, D) Axial and sagittal contrast-enhanced CT images reveal a heterogeneous hypoattenuating trans-spatial mass, with peripheral rim enhancement (arrow). This mass is centered in the left side of the retropharyngeal space (r) and extends laterally to the perivertebral space (v), the most superficial and US-accessible part of the lesion. Displacement of the internal carotid artery anteriorly (white arrow) and partial collapse of the upper airway are also seen (red arrow).

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**Fig. 7:** Left anterior neck abscess due to *Haemophilus influenzae* and *Staphylococcus intermedius* in a 3-year-old girl who presented to the emergency department with fever and neck swelling. At this location, an underlying third or fourth branchial cleft anomaly (non-sustained in this case) should be considered. (A) Longitudinal grayscale US image shows a huge, ill-defined, hypoechoic lesion (arrows) medial to the sternocleidomastoid muscle (s). (B, C, D) Axial and coronal contrast-enhanced CT images reveal a heterogeneous hypoattenuating and ring-enhanced mass (arrows) deep to the sternocleidomastoid muscle (s) and anterior to the carotid sheath (red arrows). Right displacement of the trachea is also notorious (blue arrows).

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Fig. 8: Left neck abscess due to Streptococcus agalactiae in a 3-year-old girl who presented to the emergency department with fever and neck swelling. At this site, the diagnosis of infected second branchial cleft cyst (non-sustained in this case) should be cogitated (A) Transversal gray-scale US image shows an ill-defined, hypoechoic lesion. (B, C, D) Axial and coronal contrast-enhanced CT images reveal a heterogeneous hypoattenuating and ring-enhanced mass deep to the sternocleidomastoid muscle (s), posterior to the submandibular gland (white arrow) and anterior to the carotid sheath (red arrows).

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Fig. 9: Axial contrast-enhanced CT images in four patients with clinically diagnosed tonsillitis. (A) A left hypodense tonsillar phlegmon with no peripheral enhancement is seen. (B) Enlargement of both palatine tonsils is seen, with heterogeneous striated enhancement. Low-density areas represent parenchymal edema. (C) A peripherally enhancing fluid collection with mass effect on the oropharynx may be seen in the left peritonsillar region (arrow), in relation to peritonsillar abscess. (D) A complex right peritonsillar abscess is found (arrow), with an enhanced internal septum.

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**Fig. 10:** Retropharyngeal and danger space phlegmon in a 6-year-old boy who presented to the emergency department with neck stiffness. (A) Axial contrast-enhanced CT image demonstrates fluid in the retropharyngeal and danger spaces at the level of the oropharynx. (B, C) Sagittal contrast-enhanced CT images at different levels better depicts its inferior extension to the infra-hyoid neck.

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**Fig. 11:** Suppurative adenitis of a retropharyngeal node in a 3-year-old boy who presented to the emergency department with fever. (A, B) Axial and sagittal contrast-enhanced CT images show a hypodense ring-enhanced collection in the left retropharyngeal space (white arrows), representing suppurative adenitis causing abscess. Anterior displacement of the left parapharyngeal space is seen (red arrow).

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**Fig. 12:** Retropharyngeal abscess due to group A beta-hemolytic streptococci in a 10-month-old boy who presented to the emergency department with fever, stridor and left posterior neck swelling. (A, B) Axial and sagittal contrast-enhanced CT images show a large retropharyngeal fluid collection (white arrow) with peripheral rim-like enhancement, extending posteriorly and laterally to the left perivertebral space. Partial collapse of the upper airway (red arrow) and anterior displacement of the internal carotid artery (blue arrow) are seen.

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Fig. 13: Masticator space abscess due to Streptococcus agalactiae in a 16-year-old boy who presented to the emergency department with toothache and left neck swelling. No iodinated contrast material was administered due to antecedents of severe allergies. (A, B, C) Axial and coronal non-enhanced CT images in soft-tissue window settings reveal an abscess of the left masticator space, occupying the submasseteric space (white arrows) and extending deeply into the pterygomandibular space (blue arrows). Displacement of the masseter muscle (m) and stranding of the parapharyngeal space (black arrow) are also found. (D) Coronal CT reconstruction in bone window settings shows several carious lesions (red arrow) at the upper quadrants.

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**Fig. 14:** Laryngeal foreign body in a 14-month-old boy. (A) Frontal neck radiograph depicts an elongated radiopaque foreign body (arrow) at the upper neck. (B) Lateral neck radiograph demonstrates the laryngeal location of the foreign body (arrow). A laminated bone was retrieved at laryngoscopy.

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Fig. 15: Pharyngeal foreign body and retropharyngeal abscess due to Stenotrophomonas maltophilia in a 3-year-old girl who presented to the emergency department with dysphagia and throat pain. (A) Lateral neck radiograph shows diffuse enlargement of the prevertebral space (arrowheads), with mixed soft tissue and gas densities. (B, C) Axial contrast-enhanced CT images identify a radiopaque foreign body at the level of the right pyriform sinus (red arrows). An adjacent retropharyngeal fluid and gas collection with rim enhancement is found (blue arrows). (D) Sagittal contrast-enhanced CT image better depicts the extent of the retropharyngeal abscess (white arrows). A bone was retrieved at endoscopy.

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Fig. 16: Spondylodiscitis and prevertebral phlegmon. (A, B) Sagittal non-enhanced CT images displayed in soft-tissue and bone window settings show cortical destruction and partial collapse of the C3 vertebral body (blue arrow), prevertebral phlegmon (white arrow), and posterior epidural thickening (arrowhead). (C) Sagittal contrast-enhanced fat-suppressed T1-weighted MR image shows enhancement of the C3 and C4 vertebral bodies, the prevertebral phlegmon (white arrow) and the epidural space (red arrowhead). (D) Sagittal STIR MR image demonstrates slight increased signal of the C3 and C4 vertebral bodies, and decreased signal of the C3-C4 disc (white arrowhead). No compression of the spinal cord is found.

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**Fig. 17:** Intervertebral disk calcification and intraspongious hernia in an 8-year-old girl presenting to the emergency department with cervical pain. (A, B) Sagittal and coronal CT images displayed in bone window settings show a kyphotic cervical curvature, small calcifications within the C3-C4 disc (white arrowheads), and a lucent area within the C4 vertebral body, representing an intraspongious hernia (black arrowheads). (C) Sagittal STIR MR image shows increased signal of the C4 vertebral body (blue arrowhead) and the pulpous nucleus of the subjacent disc, in relation to intraspongious hernia. (D) Sagittal contrast-enhanced fat-suppressed T1-weighted MR image demonstrates a signal void within the C3-C4 disc, representing calcification (blue arrowhead).

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**Fig. 18:** Facet joint transient synovitis in a 5-year-old girl who presented to the emergency department with acute neck pain. (A) Frontal neck radiography with no evident pathological changes. (B, C) Coronal STIR MR images show bilateral facet joint effusion (arrows) at the C2-C3 level, essentially at the right side.

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Conclusion

Radiologists should know the specificities of pediatric neck disorders and guide patients towards the most accurate imaging tool, according to the pathology and the clinical status. Overall, US remains the first-choice for the evaluation of neck diseases. Despite the risks associated to ionizing radiation exposure, some indications for neck CT examinations at the emergency department should offer no doubt. The distinction between phlegmon and abscess, depiction of the exact lesion extent, and exclusion of life-threatening conditions like retropharyngeal abscess, airway obstruction, mediastinitis, and vascular complications, are the most significant indications. Some particular cases like non-complicated aspiration or ingestion of foreign bodies may be clarified using conventional radiography and posterior bronchoscopy or endoscopy. On its turn, MRI is indicated when osteomyelitis, spondylodiskitis, septic arthritis, and spinal cord lesion are suspected. Finally, some US-identified lesions need further CT or MRI evaluation. In the absence of clinical suspicion of life-threatening conditions, elective MRI may be a better option to corroborate its etiology and depict the extent of the lesion, thus preventing ionizing radiation exposure.
References


