Chapter 5
Head and Neck Ultrasound

Using point-of-care ultrasound to evaluate head and neck pathology is a relatively new and evolving entity. One of the more routine but common indications to perform this exam is to assess for and assist with incision and drainage of a peritonsillar abscess. However, there are other areas of interest such as the thyroid gland, parotid gland, and carotid artery. In addition, assessing for proper endotracheal tube location can now be done immediately following intubation using ultrasound techniques. While head and neck ultrasound may be intimidating to the novice sonographer, the technical skills needed to obtain and interpret these images are quite simple due superficial and easy-to-identify structures. Therefore, with minimal practice, one can become an expert in head and neck ultrasound. This chapter will review indications to perform a head or neck ultrasound, basic anatomy, image acquisition, normal ultrasound anatomy, and interpretation of pathology.

Tonsillar Ultrasound

(a) Clinical Application and Indications

- Asymmetrical tonsillar enlargement.
- Evaluate for peritonsillar abscess.

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(b) Tonsillar Anatomy

- Paired lymphatic structures located in the posterior oropharynx

(c) Transducer Selection

- Endocavitary transducer

(d) Patient Position

- Have the patient sit upright with the back of their head supported by the head of the bed [1].

(e) Standard Exam Views

- Insert the transducer into the patient's mouth.
- Place the head of the transducer against the affected tonsil.
  - Figure 5.1—Endocavitary transducer in mouth
- Very slowly fan the transducer to evaluate for signs of a fluid collection indicating peritonsillar abscess or cobblestoning indicating tonsillar edema.
- Compare to the unaffected side.
- Identify the carotid artery posterior to the tonsil.
  - Figure 5.2—Carotid artery posterior to the tonsil
  - Video 5.1—Carotid artery posterior to the tonsil

FIGURE 5.1 Endocavitary transducer position for tonsillar ultrasound: The endocavitary probe should be inserted to view the affected tonsil. It can help to have the patient direct you as they will be more comfortable this way

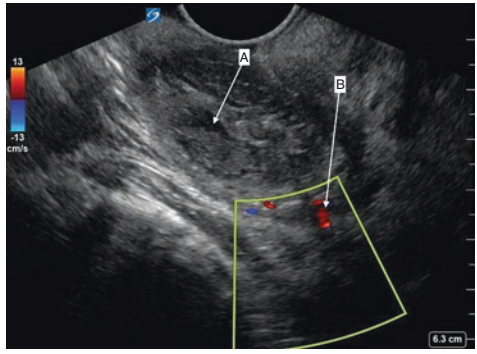


FIGURE 5.2 Carotid artery posterior to tonsil: The carotid artery (B) can be visualized posterior to the tonsil. A peritonsillar abscess can be seen in this image (A)

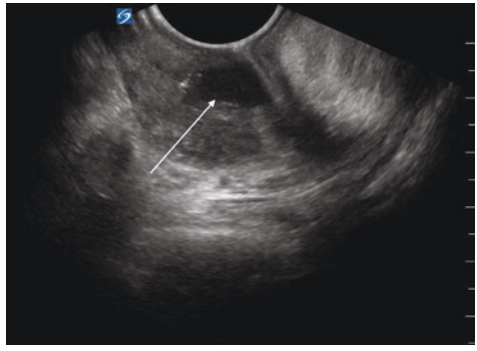


FIGURE 5.3 Peritonsillar abscess: A large area of hypoechoic fluid (arrow) represents a peritonsillar abscess

(f) Peritonsillar Abscess

- Walled-off bacterial infection resulting in a collection of purulent fluid within the tonsil, usually due to sequelae of bacterial pharyngitis.
- Will appear as a hypoechoic fluid collection within an asymmetrically enlarged tonsil.
  - Can contain complex fluid with internal echoes and debris
  - Figure 5.3—Peritonsillar abscess
  - Video 5.2—Peritonsillar abscess
- Measure the size of the abscess.
- Measure the depth of the abscess cavity from the transducer [1].
  - Based on this measurement, choose the appropriate needle length.

FIGURE 5.4 Needle with plastic cap cut: To avoid entering too far into the peritonsillar space, a needle cap can be cut to only allow a set amount of needle to enter

  - Place the plastic cap on the needle and cut the cap a distance back from the needle tip that is just longer than this measurement.

Figure 5.4—Needle with plastic cap cut

  - This will ensure the needle does not enter the tonsil too far putting the carotid artery at risk for injury.

- Perform incision and drainage of the abscess using landmarks or direct ultrasound guidance.
- Reimage the tonsil to evaluate for improvement of the fluid collection.

(g) Key Points

- When evaluating for a peritonsillar abscess, the patient may have limited ability to open the mouth secondary to trismus.
- Have the patient hold their tongue down themselves with a tongue depressor or even a laryngoscope as they will know their own gag reflex.

Thyroid Ultrasound

(a) Clinical Application and Indications

- Evaluation of a palpable neck mass [2]
- Thyroid enlargement
- Abnormal thyroid function labs
- Further evaluation of an incidental finding on other imaging studies such as thyroid nodule or cyst [2]

(b) Thyroid Anatomy

- A superficial endocrine organ in the neck that overlies the trachea.
- The isthmus of the thyroid is the connection between the right and left lobes and usually lies over the second or third tracheal ring.
- Each lobe is located anterior and lateral to the trachea, with the carotid artery and internal jugular veins located posteriorly.

(c) Transducer Selection

- Linear array transducer

(d) Patient Position

- The patient should be supine or in a semi-recumbent position with their neck extended.

(e) Standard Exam Views

- Begin by imaging the thyroid gland in a transverse plane.

FIGURE 5.5 Transducer position on neck: For thyroid ultrasound, having the patient sit in a supine position slightly recumbent can facilitate easy scanning of the neck

- Place the transducer below the laryngeal prominence with the marker pointed toward the patient's right.
  - Figure 5.5—Transducer position
- Scan inferiorly until the isthmus of the thyroid is visualized.
  - Thyroid gland will appear as a uniform, finely granular structure that is slightly more echogenic than the surrounding musculature [3].
  - Isthmus will be seen anterior to the hyperechoic trachea with the left and right lobes on either side, respectively.
  - Figure 5.6—Isthmus of the thyroid.

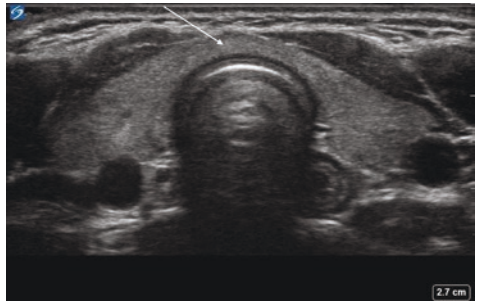


FIGURE 5.6 Isthmus of thyroid: The isthmus of the thyroid (arrow) will be seen anterior to the hyperechoic trachea

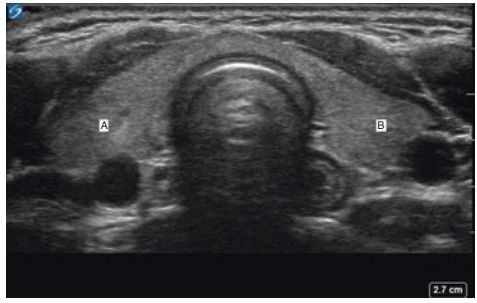


FIGURE 5.7 Thyroid lobes: Right (A) and left (B) thyroid lobes

- Move the transducer laterally to each side to image the right and left lobes of the thyroid.
  - Figure 5.7—Thyroid lobes.
  - Lateral to each lobe will be the paired thick-walled anechoic and pulsatile carotid artery followed by the thinner-walled internal jugular vein [4].
  - The esophagus is often found posterior to the left thyroid lobe and anterior to the cervical vertebral body [3].

    Visualized as an oval or flattened structure with alternating hypo- and hyperechogenicity [3].

  - Figure 5.8—Thyroid and surrounding structures.
  - Video 5.3—Thyroid ultrasound.

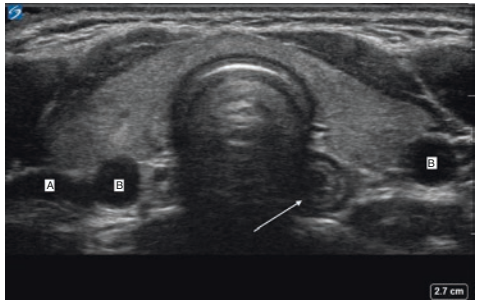
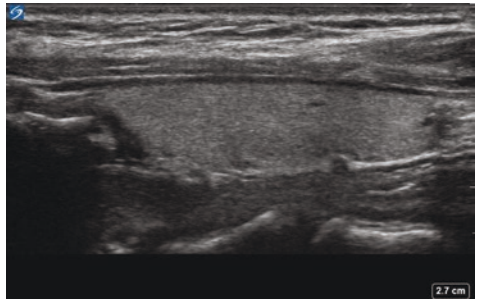


FIGURE 5.8 Thyroid with surrounding structures: Lateral to each thyroid lobe will be the paired thick-walled anechoic and pulsatile carotid arteries (B) followed by the thinner-walled internal jugular veins (A). The esophagus (arrow) is often found posterior to the left thyroid lobe and anterior to the cervical vertebral body

FIGURE 5.9 Thyroid in a sagittal plane: Left lobe of the thyroid visualized in sagittal plane



- Rotate the transducer clockwise 90° with the marker pointed cephalad. Image each lobe of the thyroid in a sagittal plane.
  - Figure 5.9—Thyroid in a sagittal plane
  - Video 5.4—Thyroid in sagittal plane
- Apply color Doppler to each area of the thyroid to evaluate vascular flow.
  - Figure 5.10—Color Doppler of the thyroid gland
  - Video 5.5—Color Doppler of the thyroid gland

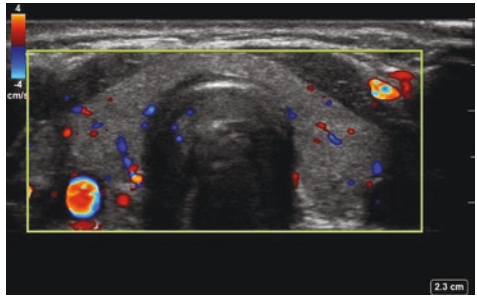


FIGURE 5.10 Color Doppler of the thyroid gland: Normal vascular flow of the thyroid gland using color Doppler

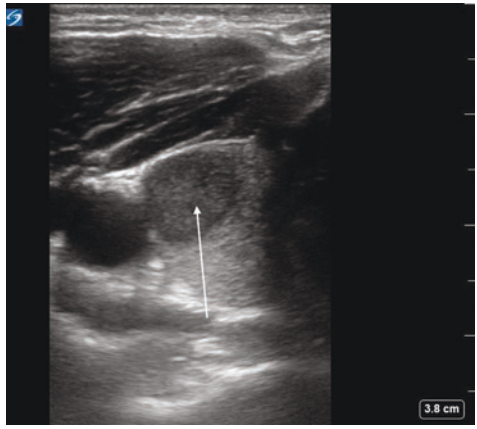


FIGURE 5.11 Thyroid nodule: A thyroid nodule (arrow) is a distinct lesion within the thyroid that is formed by an overgrowth of thyroid cells

(f) Thyroid Pathology

- Thyroid nodule
  - Lesion within the thyroid gland caused by an overgrowth of thyroid cells.
  - Majority of thyroid nodules are benign with only about 5% malignant [5].
  - Common incidental findings on computed tomography or with ultrasound of the thyroid.
  - Will appear as a discrete lesion that distorts the normal thyroid echotexture [4].
  - Figure 5.11—Thyroid nodule.

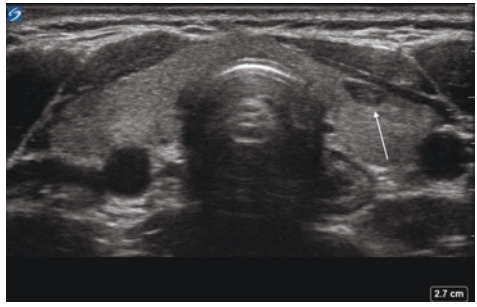


FIGURE 5.12 Thyroid cyst: Thyroid cysts (arrow) are a type of benign nodule that can be simple, colloid, or hemorrhagic

- Thyroid Cyst
  - A type of benign thyroid nodule.

    Can be simple, colloid, or hemorrhagic
  - Simple cysts will appear as round, anechoic, or hypoechoic structures with posterior acoustic enhancement.
  - Figure 5.12—Thyroid cyst.
  - Video 5.6—Thyroid cyst.
- Thyroiditis
  - Inflammation of the thyroid gland
  - Will appear as decreased echogenicity with increased vascularity resulting in increased flow with color Doppler [6]
  - Figure 5.13—Thyroiditis
  - Video 5.7 Thyroiditis

Tracheal Ultrasound

- Clinical Application and Indications
  - Confirm endotracheal tube placement.
- Trachea Anatomy
  - Located superficially in the anterior neck.
  - Membranous tube that connects the pharynx and larynx to the lungs.

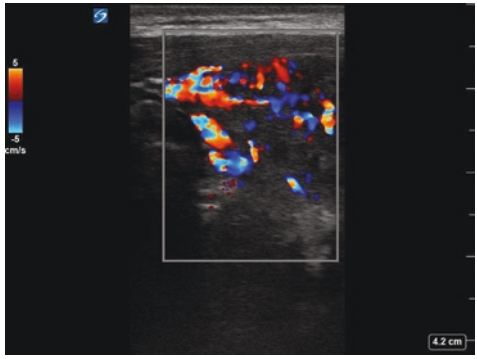


Figure 5.13 Thyroiditis: With any inflammatory state of the thyroid, there will be increased vascular flow as evidenced here by placing color Doppler over the thyroid gland.

  - Reinforced by anterior rings of cartilage.
  - The cricothyroid membrane sits between the thyroid cartilage superiorly and cricoid cartilage inferiorly.

- Transducer Selection
  - Linear array transducer
- Patient Position
  - This exam will typically be performed on an intubated patient; therefore, the patient should be supine or with the head of the bead elevated to 30°.
- Standard Exam Views
  - Place the transducer on the midline anterior neck in a transverse plane.

    Figure 5.14—Transducer placement over the trachea.

    The trachea will appear as an echogenic curved stripe with posterior acoustic shadowing.

    Figure 5.15—Trachea.

    Video 5.8—Trachea.
  - Scan both cranially and caudally to evaluate the trachea.

FIGURE 5.14 Transducer placement over trachea: To visualize the trachea, place the transducer in a transverse orientation over the center of the neck

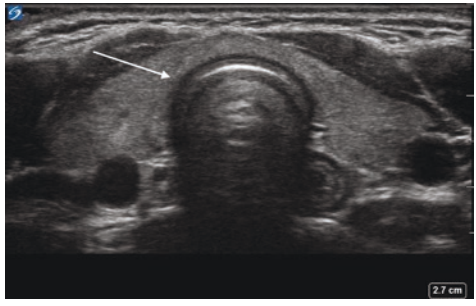


FIGURE 5.15 Trachea: The trachea (arrow) will appear as an echogenic curved stripe with posterior acoustic shadowing

– Attempt to visualize the esophagus located to the left; this can be enhanced by asking the patient to swallow.

Typically found posterior to the left lobe of the thyroid gland

Figure 5.16—The trachea and esophagus

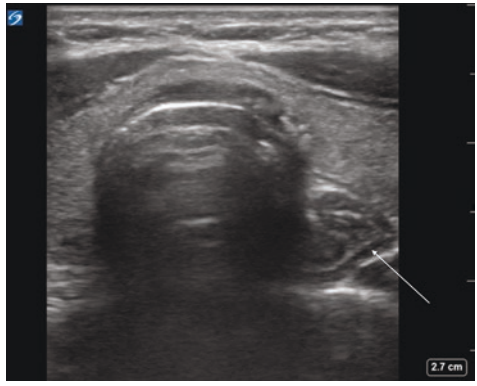


FIGURE 5.16 Image of trachea with esophagus identified: Attempt to visualize the esophagus (arrow), which is located to the left of the trachea (on the right of the image) as seen here

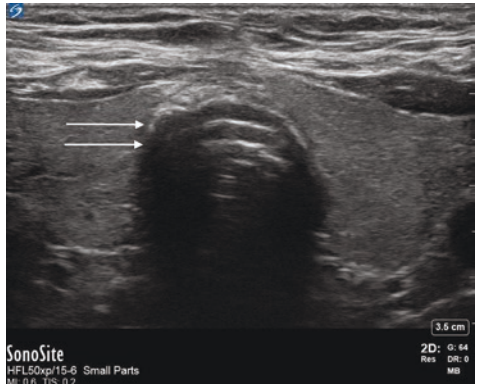


FIGURE 5.17 Correct ETT placement: With correct placement of an endotracheal tube, two curved parallel echogenic lines (arrows) will be seen

- Confirmation of Endotracheal Tube Placement
  - Ultrasound the trachea as described above.
  - With correct placement of an endotracheal tube, two curved parallel echogenic lines will be seen [3] with more prominent posterior acoustic enhancement [7] and an increased amount of B-lines.

    Figure 5.17—Correct ETT placement
    Video 5.9—Correct ETT placement

  - Slight shaking or movement of the tube will demonstrate movement of the trachea on ultrasound.

- Esophageal Intubation
  - Incorrect placement of an endotracheal tube will be visualized as an echogenic curved line with posterior acoustic shadowing posterior and lateral to the trachea [7].

    Usually posterior to the left lobe of the thyroid gland [3]
    Occasionally referred to as "double trachea sign" [7]

- Key Points
  - Endotracheal tube confirmation can also be performed in real time by visualizing the tube [7] in long [3] or short axis as the tube is placed.
  - Using ultrasound to confirm endotracheal tube placement has been found to have a sensitivity and specificity of 98% [8].

Carotid Artery Ultrasound

- Clinical Application and Indications
  - Evaluate for carotid artery dissection.
- Carotid Artery Anatomy
  - The right carotid artery is a branch of the brachiocephalic artery.
  - The left carotid artery branches directly off the arch of the aorta.
  - Splits into the external and internal carotid arteries at the level of the fourth cervical vertebrae, just distal to the carotid bulb.
- Transducer Selection
  - Linear array transducer
- Patient Position
  - Have the patient lay supine or in a semi-recumbent position with their neck extended and head facing away from the side being imaged.
- Standard Exam Views
  - Place the transducer in a transverse plane, just above the clavicle to obtain a short axis view of the carotid artery.

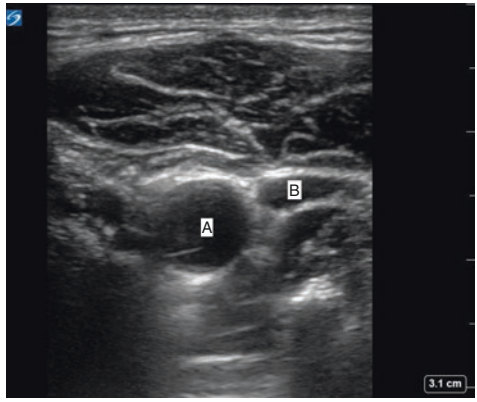


FIGURE 5.18 Short axis of the carotid artery: In a transverse plane, the carotid artery will be imaged in short axis appearing as a thick-walled anechoic vessel (A) next to the thin and collapsible vein (B)

  - Scan cranially to evaluate the entire length of the carotid artery.

    Figure 5.18—Short axis of the carotid artery

  - Switch to long axis by rotating the transducer marker toward the patient's head and scan cranially to evaluate the carotid bulb.

    Figure 5.19—Long axis with carotid bulb

- Carotid Artery Dissection
  - Separation of the inner wall of the carotid artery creating a false lumen.
  - Appears as a hyperechoic linear stripe within the lumen of the carotid artery.

Salivary Gland

(a) Clinical Application and Indications

- Preauricular pain and/or swelling

(b) Basic Anatomy

- Parotid gland
  - Located anterior to the ear bilaterally with the upper portion nearly in line with the external auditory meatus [3].

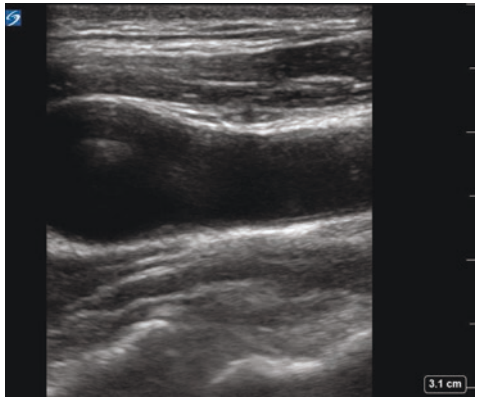


FIGURE 5.19 Long axis with carotid bulb labeled: In long axis, with the transducer oriented so the marker is pointed toward the patient's head, the carotid artery will appear as an anechoic tube with the carotid bulb locater more superior

  - Parotid gland duct courses from the anterior surface of the gland through buccal fat and buccinator muscle. It enters the mouth adjacent to the second upper molar as the parotid papilla [3].

- Submandibular gland
  - Triangular shaped within the submandibular triangle [3] inferior to the mandible.
  - Submandibular duct courses medially then superiorly where it enters the mouth as a papilla near the lingual frenulum [3].

(c) Transducer Selection

- Linear array transducer

(d) Patient Position

- Position the patient in a position of comfort. They can be supine, semi-recumbent, or sitting up with the back of their head supported.
- When imaging the submandibular gland, it may be helpful to tilt the patient's head up.

FIGURE 5.20 Transducer position parotid gland: Place the transducer near the angle of the jaw with the marker pointed superiorly

(e) Standard Exam Views

- Parotid gland
  - Begin by imaging the parotid gland in a sagittal plane with the transducer marker pointed superiorly.

    Figure 5.20—Transducer position parotid gland
  - Parotid gland will have a homogeneous, finely granular echotexture [3].

    Figure 5.21—Parotid gland
    Video 5.10—Parotid gland
  - Scan through the gland looking for any abnormalities.

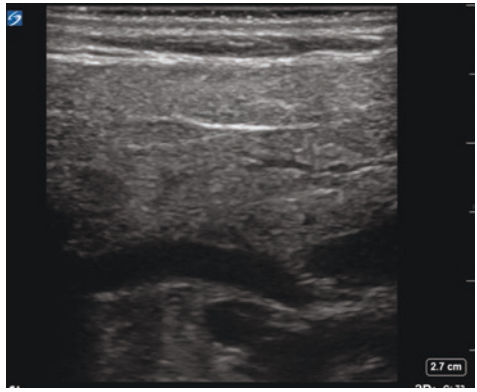


FIGURE 5.21 Parotid gland: The parotid gland is seen just below the skin with a homogenous, finely granular echotexture

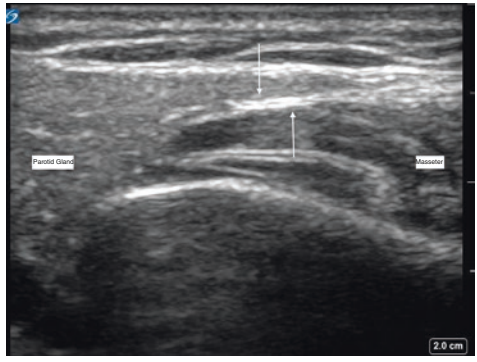


FIGURE 5.22 Parotid duct: The parotid duct will appear as two thin parallel hyperechoic lines coursing over the masseter muscle (arrows)

  - Rotate the transducer counterclockwise with the transducer marker pointed toward the patient's right to image the parotid duct in a transverse plane.
  - Line the transducer up with the earlobe near mid-cheek to identify the duct as two thin hyperechoic lines close together and parallel [3].

Figure 5.22—Parotid duct

- Submandibular gland
  - Place the transducer within the submandibular space anterior to the angle of the mandible.

FIGURE 5.23 Transducer placement submandibular gland: Place the transducer inferior to the mandible within the submandibular space to visualize the submandibular gland

Figure 5.23—Transducer placement submandibular gland

– Identify the gland just beneath the subcutaneous tissue as a homogeneous structure with intermediate echogenicity [9], similar to the parotid gland.

Figure 5.24—Submandibular gland
Video 5.11—Submandibular gland

– The facial artery and vein will be seen near the gland [9].

(f) Salivary Gland Pathology

- Sialolithiasis
  - Stone within a salivary gland or duct.
  - Found within the parotid gland and, more commonly, the submandibular gland [3] or duct.
  - Visualized as echogenic foci with posterior acoustic shadowing [3], similar to gallstones or renal stones.
  - If obstructed, the duct will become dilated representing a small anechoic tube leading to an echogenic stone [3].

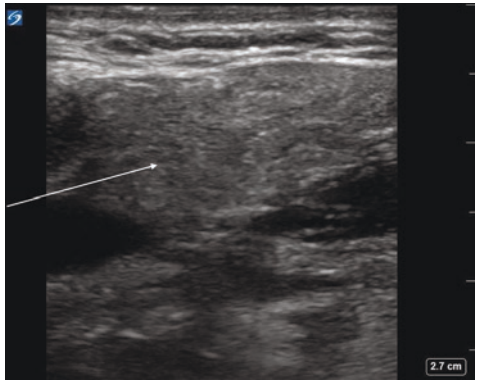


FIGURE 5.24 Submandibular gland: Submandibular gland (arrow) appears as a homogenous structure, similar to the parotid gland, just deep to the subcutaneous tissue

- Sialadenitis
  - Inflammation or infection of a salivary gland.
  - Gland will appear enlarged with a more heterogeneous, echogenic architecture as compared with normal salivary gland tissue [3].
  - Can also see increased blood flow on color Doppler [3].
- Salivary gland mass
  - Benign (most common) or malignant lesion of a salivary gland, usually the parotid gland [3].
  - Solid masses will appear with mixed echogenicitiy with some hypoechoic areas. There may be posterior acoustic enhancement [3].
  - Cystic masses will typically appear similar to cysts elsewhere as an anechoic lesion [3].

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