Journal meeting

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Use of Sonography for Airway Assessment

J Ultrasound Med 2010; 29:79–85

Introduction

- Sonography of the upper airway may be a useful clinical methods of bedside airway assessment
- There is limited published data on sonography of the airway

Objective

- To evaluate the feasibility of sonography in identifying airway anatomic structures from the floor of the mouth to the suprasternal notch in the anterior aspect of the neck
- To determine the optimal scanning technique in terms of transducer selection and orientation
- To describe the sono anatomy of the airway

Materials and Methods

- Enrolled 24 healthy volunteers and performed a systematic sonographic examination of their airway
- Examination was performed by a certified sonographer with experience in sonography of the head and neck
- Placed supine with their head extended and neck flexed (the “sniffing” position)

- The ultrasound transducer was oriented in 1 of 3 ways:
  (1)longitudinally in the midline (the sagittal view)
  (2)longitudinally 2 cm lateral to the midline (the parasagittal view)
  (3)transversely across the anterior surface of the neck (the transverse view)

Results

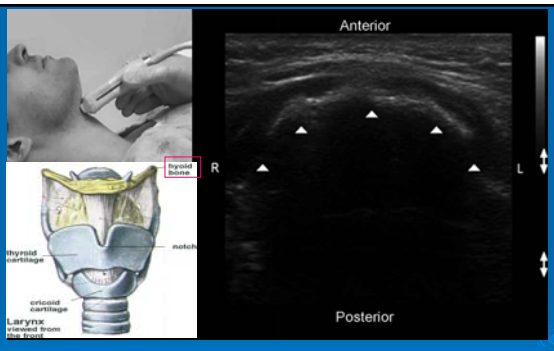
- ***General Observations***
- **Bony structures** appeared as bright hyperechoic linear structures with a hypoechoic acoustic shadow underneath
- **Cartilaginous structures** were homogeneously hypoechoic and their intraluminal surface was outlined by a bright air-mucosa interface

- **Muscles and connective tissue membranes** were also hypoechoic but with a more heterogeneous striated appearance
- **Glandular structures** were homogeneous and mildly to strongly hyperechoic in comparison with adjacent soft tissues, depending on the fat content in the glandular parenchyma

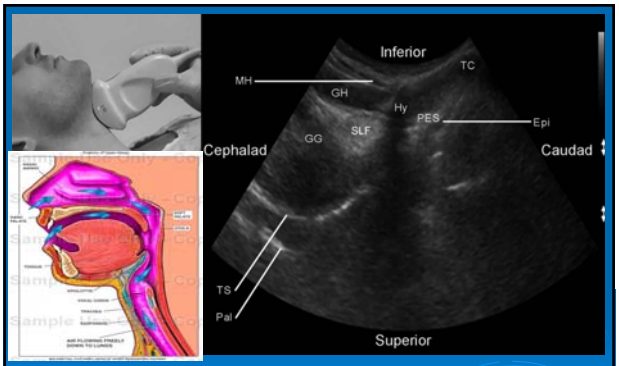
- Any interface between the mucosa lining the upper airway tract and the air within it (an air-mucosa [A-M] interface) had a bright hyperechoic linear appearance

Hyoid Bone

- was a key landmark that separated the upper airway into 2 scanning areas: the suprahyoid and infrahyoid regions
- on sagittal view, the hyoid bone was visible as a narrow hyperechoic curved structure that cast an acoustic shadow (Figure 2)



Hyoid bone on a midline transverse view is shown as an inverted U hyperechoic curvilinear line (arrowheads) with posterior acoustic shadowing

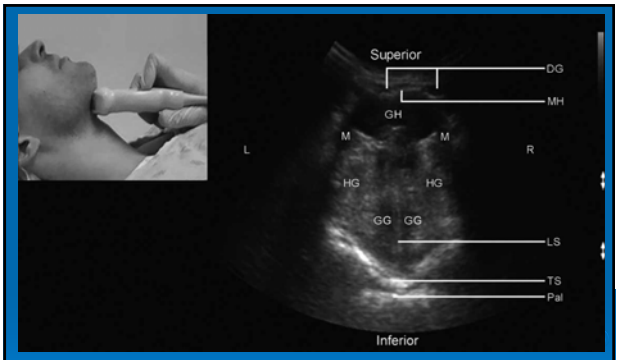


Extended submandibular sagittal view shows dorsal part of tongue, hyoid bone (Hy), epiglottis (Epi), and laryngeal inlet caudad to epiglottis

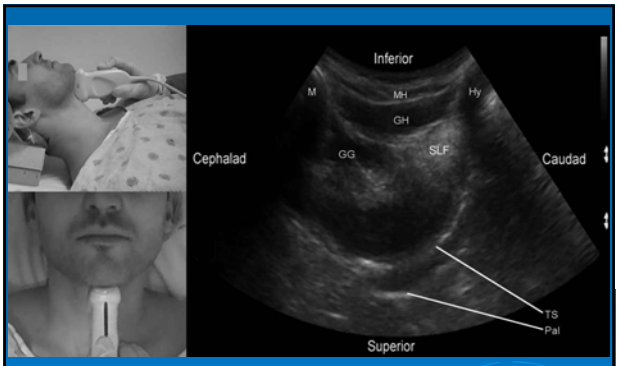
Suprahyoid Region

- The curved low-frequency transducer was preferred for imaging structures in the suprahyoid region
- ***Floor of the Mouth***

-Several hypoechoic muscle layers were visible on the transverse view at the submandibular position (transducer placed midway between hyoid bone and mentum)



Transverse view in the submandibular position
Platysma muscle is the most superficial layer and is often hard to distinguish from subcutaneous tissue

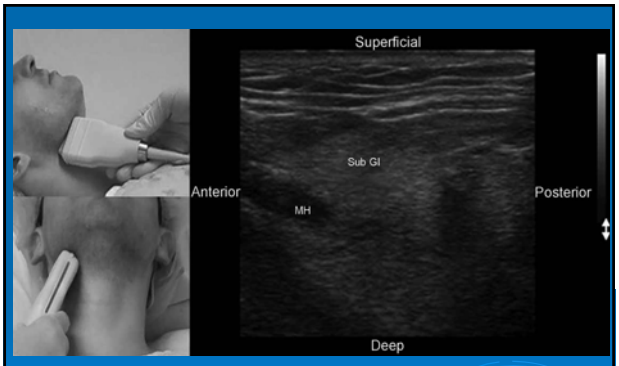


Sagittal view in the submandibular position between mentum (M) and hyoid bone (Hy)

- ***Salivary Glands***

-had a homogeneous hyperechoic appearance and were imaged best by placed in the submandibular area parallel to the mandible (Figure 5)

-The submandibular gland was triangular and was located posterior to the sublingual glands and close to the angle of mandible

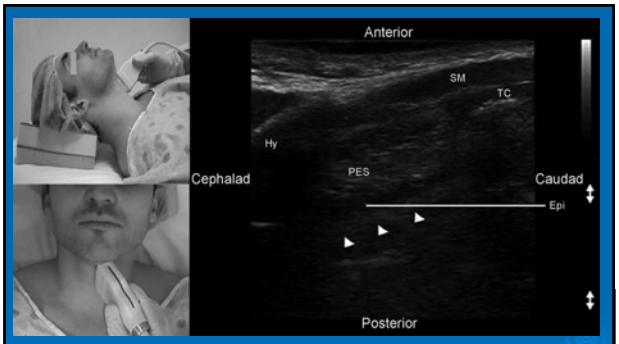


Lateral oblique view in the submandibular position parallel to the mandible

Infrahyoid Region

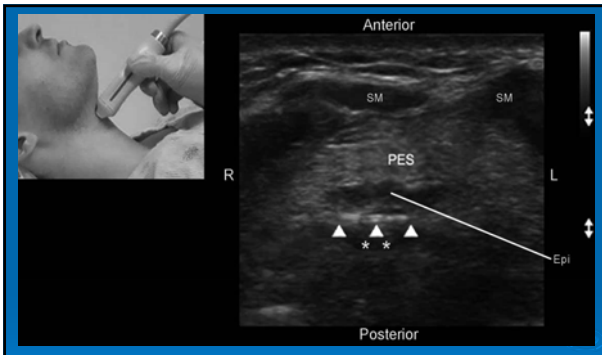
- The linear high-frequency transducer was most useful for detailed examination of the anatomic structures in the infrahyoid region
- ***Thyrohyoid Membrane***

runs between the caudal border of the hyoid bone and the cephalad border of the thyroid cartilage



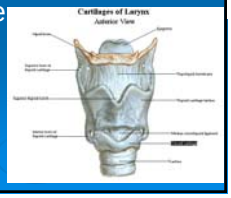
Left parasagittal scan through the thyrohyoid membrane shows the epiglottis (Epi) and the posterior A-M interface (arrowheads)

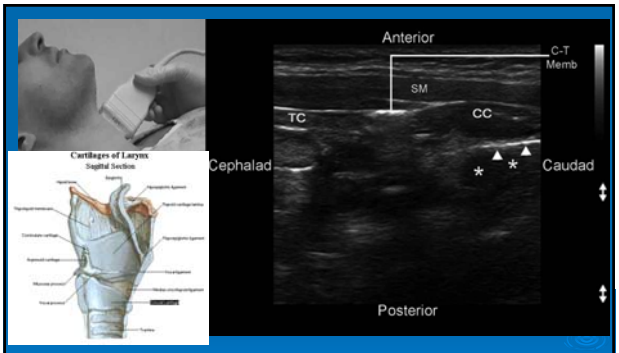
- ***Epiglottis***
  - -was visible through the thyrohyoid membrane as a hypoechoic curvilinear structure on the parasagittal and transverse views
  - -Identification was facilitated by tongue protrusion and swallowing, during which it was visible as a discrete mobile structure inferior to the base of the tongue



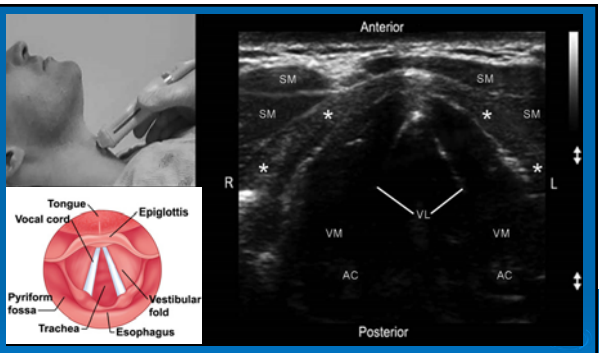
Transverse scan through the thyrohyoid membrane shows the epiglottis (Epi) and A-M interface (arrowheads)

- ***Thyroid Cartilage***
  - -was visible on sagittal and parasagittal views as a linear hypoechoic structure highlighted by the bright A-M interface at its posterior surface
- The **vocal cords** were best visualized through the thyroid cartilage

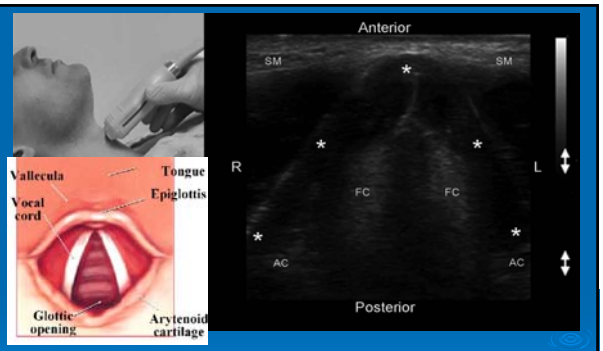




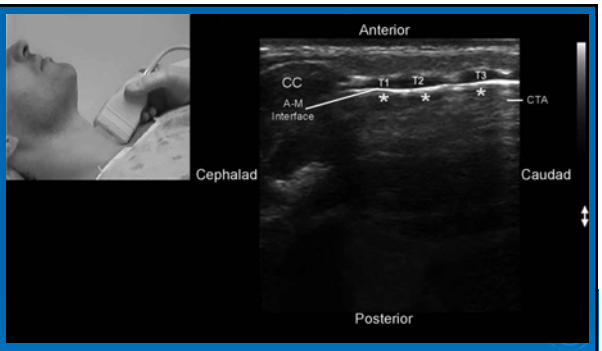
Left parasagittal scan through the cricothyroid membrane shows the cricothyroid membrane (C-T memb) and the A-M interface (arrowheads) posterior to the cricoid cartilage (CC)



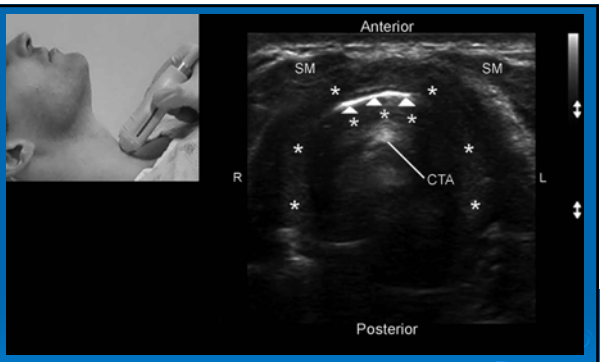
Transverse scan over thyroid cartilage shows the true vocal cords and vocal ligaments near the anterior commissure



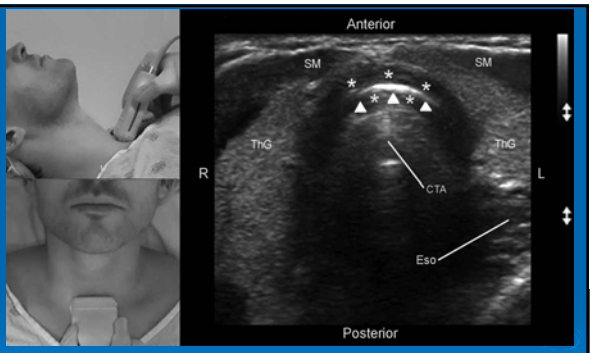
Transverse scan at the level of thyroid cartilage shows the Hyperechoic false cords (FC), the echogenicity of true and false cords is different due to increased fat content in false cords and the presence of the vocalis muscle in the true cords



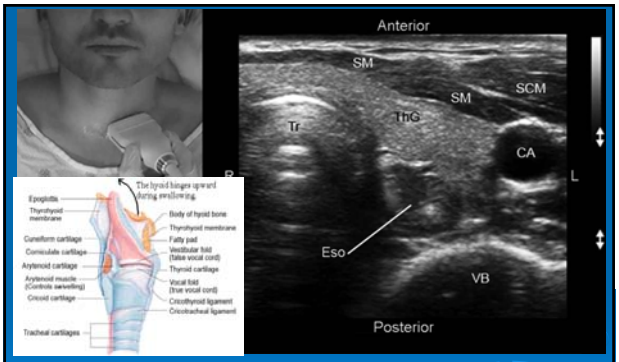
Left parasagittal scan over trachea
shows the cricoid cartilage (CC) and tracheal cartilages (T1–T3)



Transverse scan at the level of cricoid cartilage shows the cricoid cartilage with a posterior A-M interface (arrowheads)



Transverse scan at the level of suprasternal notch in midline
Shows the trachea, thyroid gland, and esophagus (Eso)



Transverse scan at level of suprasternal notch shows carotid artery (CA), esophagus (Eso) and sternocleidomastoid muscle (SCM)

Discussion

- Able to successfully visualize all of the relevant anatomic structures of the upper airway on sonography
- Clinical application of sono for upper airway with potential utility in diagnosis (eg: laryngeal abnormalities and swallowing abnormalities and identification of endotracheal tube placement)

Confirmation of endotracheal intubation by combined ultrasonographic methods in the emergency department

Emergency Medicine Australasia (2009) 21, 293–297

Introduction

- There is currently no entirely reliable method to verify the placement of the ETT
- **Primary methods :**

-direct visualization of the vocal chords

-monitoring chest rising after intubation and auscultation of both lungs

- **Secondary methods :**

-detection of end-tidal carbon dioxide levels

-use of an esophageal detector device (EDD)

-chest X-ray

-sono

-capnography

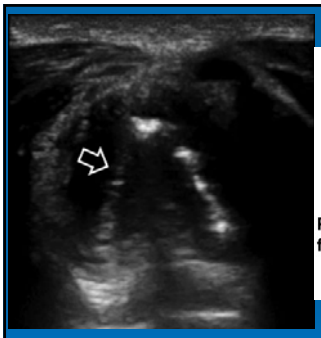
Objectives

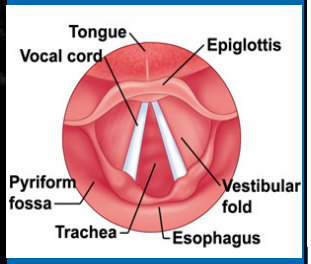
- to investigate whether the combined use of transcricothyroid membrane US and ultrasonographic evaluation for pleural sliding is useful for verifying endotracheal intubation in the ED

Methods

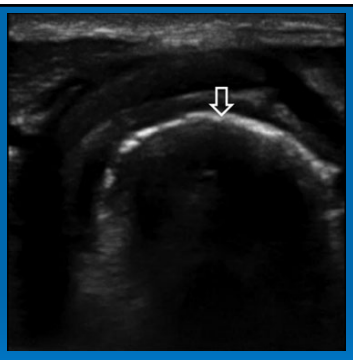
- A prospective clinical trial in the ED from January to July 2008
- All 30 patients enrolled due to severe airway problems
- A linear probe placed horizontally over the cricothyroid membrane during the intubation process (dynamic phase)
- confirmed by ultrasonographic lung sliding

- ultrasonographic lung-sliding assessment for pleural movement
- by placing the probe horizontally over the second intercostal space on the chest
- both pleural movement of parietal and visceral pleura on the chest
- ER physician confirmed the correct placement of the tube via auscultation and the use of an end-tidal CO2 detector





- before endotracheal intubation
- the triangular appearance before intubation



- Empty arrow indicates the endotracheal tube shadow
- the triangular appearance changes to a round appearance called the 'bullet sign'

Results

- The initial ratio of esophageal-to-endotracheal intubation was 3:27

Transcricothyroid membrane ultrasonography	True positive	True negative
Bullet sign (+)	26	0
Bullet sign (–)	1	3
Lung-sliding assessment		
Lung-sliding (+)	27	0
Lung-sliding (–)	0	3

	Sensitivity	Specificity	PPV	NPV
Transcrico-thyroid membrane	96.3%	100%	100%	75%
Lung sliding	100%	100%	100%	100%

- A number of authors demonstrated both highly sensitive and accurate findings

Conclusions

- The combination of transcricothyroid membrane US and lung-sliding assessment is an appropriate verification method for patients who require intubation in the ED even the patients presented with airway anatomy abnormalities or chest trauma

Thanks for your attention