ORIGINAL ARTICLE

VALUE OF ULTRASOUND IN UNDERSTANDING LARYNGEAL ANATOMY: PICTORIAL REVIEW

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ABSTRACT

The purpose of our study was to understand the normal Sonographic anatomy of human larynx. High-frequency Sonography was used to assess the normal landmarks and to understand the normal appearances of various laryngeal structures assessable to ultrasound mainly thyroid, cricoid and arytenoids cartilages and assessment of both true and false vocal cords, and outlining relationship with other structures in axial, sagittal/parasagittal and coronal planes.
Keywords: False vocal cord; high-frequency Sonography; true vocal cord.

Introduction

Assessable upper airway extending from mouth to upper trachea is completely filled with air, so it is difficult to assess their anatomy on Sonography. However, it is possible to visualize various structures in relation to the upper airway whose anatomic location which are either superficial or producing air mucosa interface.[1] In general examination of the vocal cords and other internal laryngeal structures are most commonly performed by indirect laryngoscope but this may not be tolerated by some patients especially in children and old population or may not be possible immediately in certain locations where an otorhinolaryngologist opinion is not readily available.[2] In those case we can perform quick assessment of larynx using high resolution Sonography because of its easy availability and using high contrast interface between the mucosa lining of the upper airway tract and the air within it (an air-mucosa interface) as important landmark which has a bright hyperechoic linear appearance.[3] Hyoid bone is used as an important key structure to divide the upper airway into two scanning areas: the suprahyoid above the hyoid bone and infrahyoid below the hyoid bone.[4]

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Discussion

We will try to demonstrate appearance of various laryngeal structures in axial, sagittal and coronal plane.

1. Suprahyoid level

At this level we see the pre epiglottic fat which is posteriorly bordered by the hypoechoic linear epiglottis (Fig.1). More posteriorly it is bordered by air-mucosa

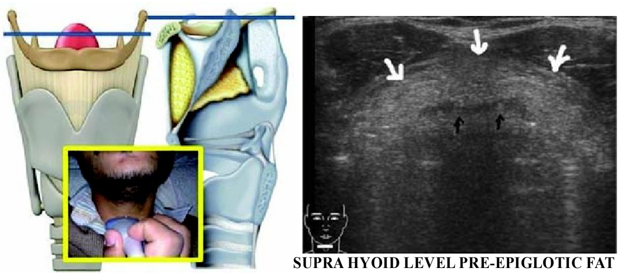

Figure 1: Axial view of suprahyoid region showing echogenic pre-epiglottic fat (white arrows) and hypoechoic epiglottis (black arrows), strap muscles are seen anteriorly.

interface giving shadowing. Epiglottis can be visualized in almost all individuals in transverse plane. Identification can also be facilitated by asking patient to protrude tongue or by swallowing. Neck strap muscles are seen anteriorly.[4]

2. Hyoid level

Hyoid bone can be easily seen in both axial and sagittal plane as hyperechoic inverted ‘U’ shaped structure with posterior acoustic shadow (Fig.2). It has limited visibility at this level due to shadowing.[1]

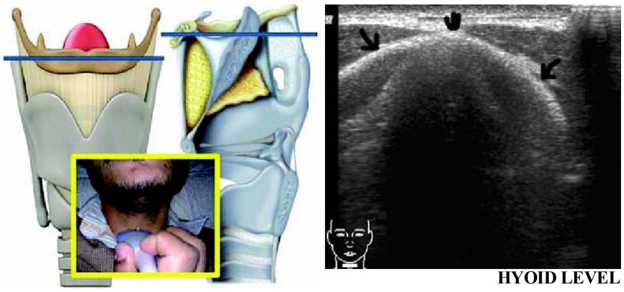

Figure 2: Axial view of hyoid region showing echogenic hyoid bone (black arrows) with posterior acoustic shadowing.

3. Infrahyoid level

Just below the hyoid bone up to the beginning of thyroid cartilage we saw mainly pre epiglottic fat which is posteriorly bordered by epiglottis (Fig.3).

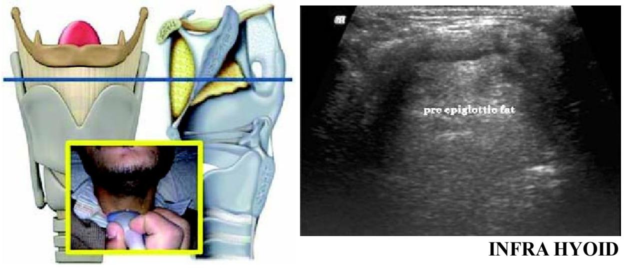

Figure 3: Axial view of infrahyoid region showing thick echogenic pre-epiglottic fat layer.

4. Thyroid cartilage upper part

Thyroid cartilage has different shapes depending upon the plane we are scanning. There is also variable amount of calcification of thyroid cartilage depending upon age of the patients.

In upper most part it appears as inverted ‘V’ shaped structure with anterior midline defect because of notch (Fig.4). In middle part it appears as complete inverted ‘V’ (Fig.5). It also provides the best window to view the vocal cords.

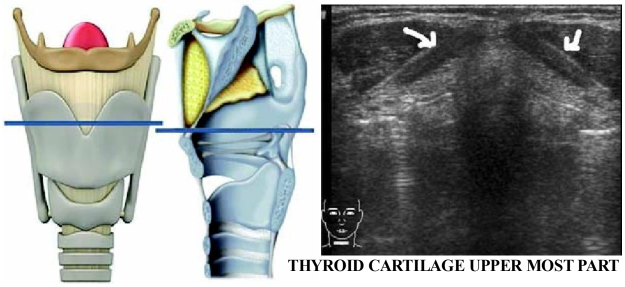

Figure 4: Axial view of Thyroid cartilage in its upper most part showing both thyroid lamina (white arrows) with suprathyroid notch, strap muscles are seen anteriorly.

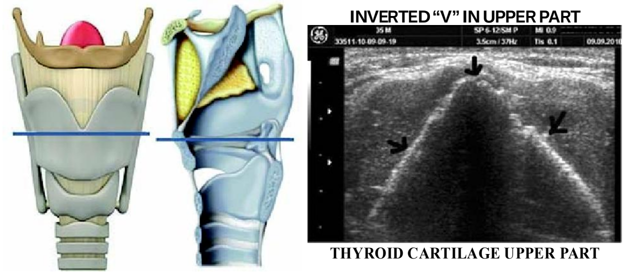

Figure 5: Axial view of Thyroid cartilage showing calcified both thyroid lamina (black arrows) giving inverted ‘V’ appearance.

5. Thyroid cartilage lower part

It appears similar to the hyoid bone (inverted ‘U’) however relatively less echogenic (Fig.6).

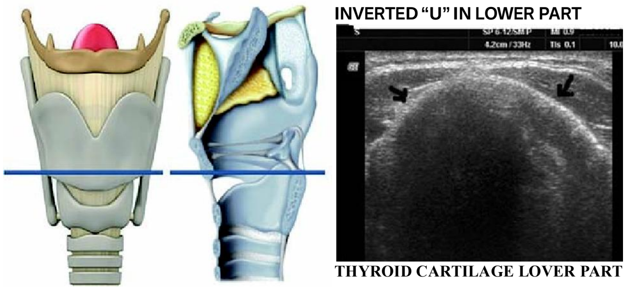

Figure 6: Axial view of Thyroid cartilage in its lower part showing calcified thyroid cartilage (black arrows) giving inverted ‘U’ appearance.

6. Cricoid level

The cricoid cartilage is very interesting structure on Sonography which shaped like a signet ring, with a narrow anterior arch widening posteriorly to the quadrate lamina (Fig.7). It is in direct contact with thyroid gland on its lateral side, however in the superior and posterior aspects the cricothyroid muscle and superior constrictor muscles of the pharynx intervene between the gland and the cartilage.[5]

The posterior lamina of the cricoids is obscured on Sonography by air in the trachea, but the sides of the ring are easily visualized in both the sagittal and transverse planes. These sides of the ring are seen as relatively hypoechoic structures with a homogenous texture, except when calcification is present.[6]

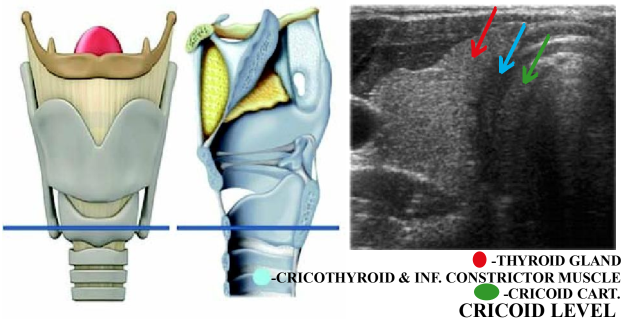

Figure 7: Axial view at cricoid cartilage level right side of neck shows relationship between cricoid cartilage (green arrow), cricothyroid muscle and inferior constrictor muscles of pharynx (blue arrow), Thyroid gland (red arrow).

7. Mid sagittal section

This section of less value as we seen calcified structure like hyoid bone, thyroid cartilage and tracheal rings which appears as 'string of beads' (Fig.8).

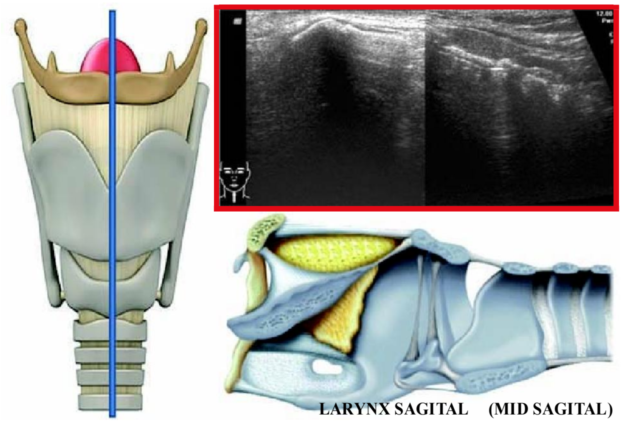

Figure 8: Mid sagittal section of larynx and upper trachea showing calcification of thyroid cartilage and tracheal rings.

8. Parasagittal section

It is very good section to view the cricoids cartilage and its relation to the thyroid gland. Cricoid appears as rounded hypoechoic structure which can be easily outlined as compared to hyperechoic thyroid gland. This can create the illusion of a thyroid mass especially in children[7] (Fig.9).

9. Coronal section

In this view we can very well demonstrate the relation of cricoids cartilage, true and false vocal cords and thyroid cartilage (Fig.10). Even the movement of cord can be very well seen on phonation.

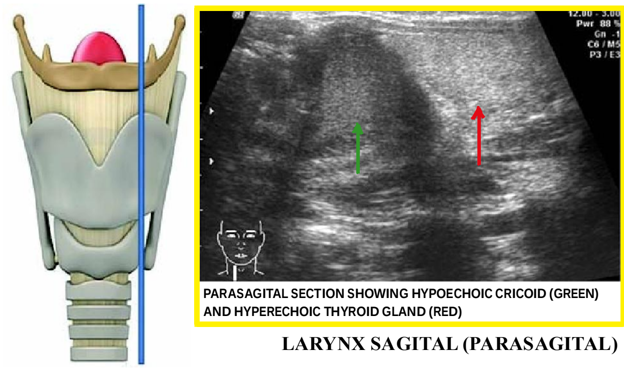

Figure 9: Para Sagittal sonogram of neck shows cricoid cartilage (green arrow) adjacent to upper pole of thyroid gland (red arrow). Cricoid cartilage gives false impression of thyroid nodule.

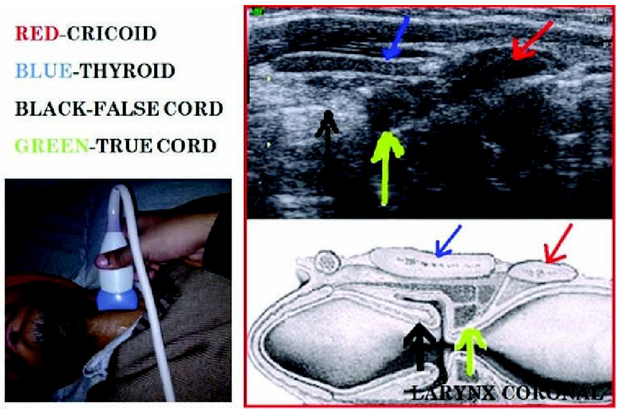

Figure 10: Coronal sonogram of neck shows relationship between thyroid (blue arrow), cricoid cartilage (red arrow), true (green arrow) and false (black arrow) vocal cords.

10. True and false vocal cords

Thyroid cartilage provides best window to view vocal cords. Vocal cords are seen forming isosceles triangle with a central tracheal shadow. Vocal cords are delineated medially by hyperechoic vocal ligament. False vocal cords lie parallel and cephalic to the true vocal cords and are more hyperechoic due the fatty nature (Fig.11). True vocal cords are hypoechopic due to muscle content and posteriorly attached to the echogenic aretynoid cartilage.[1]

Examination of the vocal cords is most commonly performed by indirect laryngoscopy but this may not readily be tolerated in some patients or may not be possible immediately in certain hospitals where an ear, nose and throat (ENT) opinion is not readily available. It has been observed that during ultrasound examination of the thyroid the vocal cords and their movement can be demonstrated using standard ultrasound equipment. When examining the vocal cords, it is important to demonstrate abduction of the cords as well as adduction (Fig.12). This is because

Semon's law which states that a partial lesion of the recurrent laryngeal nerve affects abduction before adduction. Abduction of the cords should occur on deep inspiration.[2]

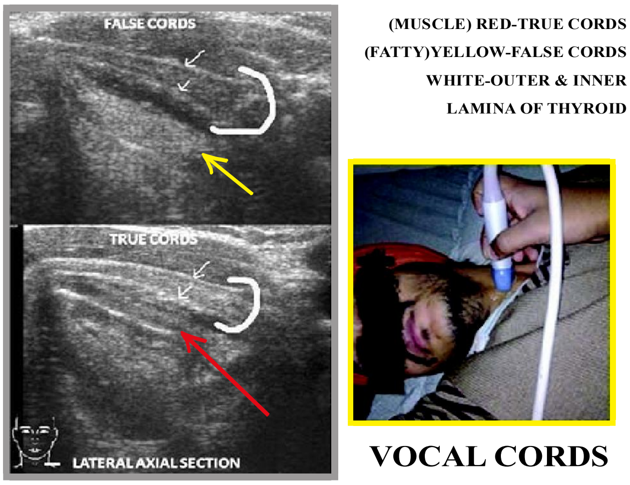

Figure 11: Lateral axial view at the level of vocal cords showing thyroid cartilage (white arrows), echogenic false cord (yellow arrow) and hypoechoic true cord (red arrow).

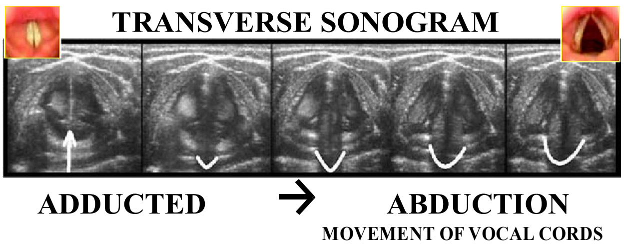

Figure 12: Axial view of vocal cords showing movement of vocal cords adduction (right) and abduction (left).

Identification is easier during phonation. If the patient is asked to phonate 'eeeee...', the cord can be seen to adduct and vibrate. The use of M-mode as well as real-time images demonstrates the movement more clearly (Fig.13). True vocal cords are mobile and completely close the glottis where as false cords are relatively immobile during phonation.

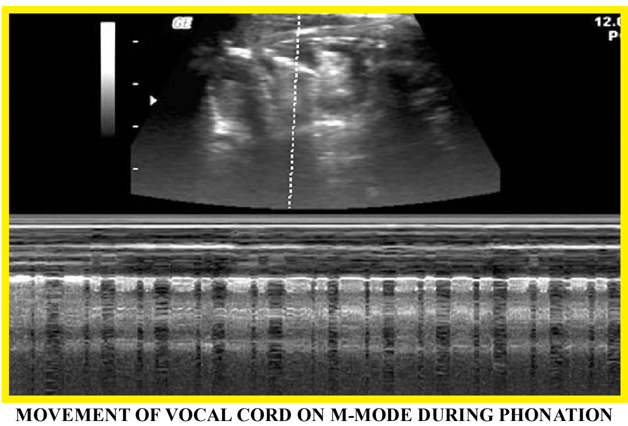

Figure 13: Lateral axial view of vocal cord showing movement of cord on 'M'-mode during phonation.

Conclusion

The High-frequency Sonography had advantage over indirect laryngoscopy that it is readily available and well tolerated by patients of all age groups, more importantly in younger age group. It can also act as adjuvant to barium swallow. Assessment of thyroid and cricoid cartilage their pattern of calcification. Abduction and adduction of vocal cords are very well demonstrated on high resolution ultrasound. Limitation of laryngeal ultrasound is calcification of thyroid cartilage with obscuration of distal structures especially in elderly individuals.

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