Can J Anesth/J Can Anesth (2009) 56:868–870
DOI 10.1007/s12630-009-9162-2

CORRESPONDENCE

Ultrasound imaging of the airway

Arun Prasad, MD · Mandeep Singh, MD · Vincent W. Chan, MD

Received: 8 June 2009 / Accepted: 21 July 2009 / Published online: 27 August 2009

To the Editor,

We read with interest the articles by Tsui *et al.*[1,2] regarding ultrasound imaging of the airway using a sublingual scanning approach. A small footprint high frequency curved transducer placed intra-orally failed to capture images of the epiglottis and the laryngeal inlet due to posterior acoustic shadowing of the hyoid bone.[1]

Transcutaneous ultrasound scanning of the airway may overcome some of these challenges. In our pilot study, we were able to image airway structures in the transverse and parasagittal (1 cm away from midline) views using a linear 38 mm, 13–6 MHz transducer with the Sonosite M-Turbo® ultrasound machine (Bothell, WA, USA).[3] The epiglottis can be visualized (Fig. 1) through the transverse and parasagittal windows both above and below the hyoid bone. Because the hyoid bone casts an acoustic shadow posteriorly, part of the epiglottis is obscured. The epiglottis is best seen through the hyo-thyroid window between the hyoid bone and the thyroid cartilage. It appears as a hypoechoic structure with a curvilinear shape on parasagittal view and an inverted 'C' on transverse view. It is related anteriorly by the hyperechoic triangular pre-epiglottic space and lined posteriorly by a hyperechoic air–mucosa interface.

A. Prasad, MD (✉) · M. Singh, MD · V. W. Chan, MD
Toronto Western Hospital, University of Toronto,
Toronto, Canada
e-mail: arun.prasad@uhn.on.ca

Compared with the sublingual technique, the transcutaneous scan has several advantages. A high frequency transducer for transcutaneous scan captures images of higher resolution. A good transducer to skin contact can be maintained even at the level of the thyroid prominence with the linear transducer in the parasagittal position. Visualization of the epiglottis is possible without ultrasound beam interference due to hyoid acoustic shadow and attenuation by hypopharyngeal air (as seen with the sublingual scan[1]). Furthermore, airway scanning at the level of the laryngeal inlet is possible and not impaired by restricted caudad transducer angulation due to the presence of upper incisors or the smaller capacity of the sublingual space (as seen with the sublingual scan). Both scanning approaches visualize tongue substance and musculature.

Future studies will determine if the sublingual and transcutaneous approaches are complementary to each other. Ultrasound may prove to be an exciting evaluation tool for airway structures and ease of intubation.

Competing interests None declared.

References

1. *Tsui BC, Hui CM*. Challenges in sublingual airway ultrasound interpretation. Can J Anesth 2009; 56: 393–4.
2. *Tsui BC, Hui CM*. Sublingual airway ultrasound imaging. Can J Anesth 2008; 55: 790–1.
3. *Singh M, Lupu M, Liang L, Wong DT, Chan VW*. Ultrasonography for airway assessment—an observational study. Anesthesiology 2008; 109: A183 (abstract).

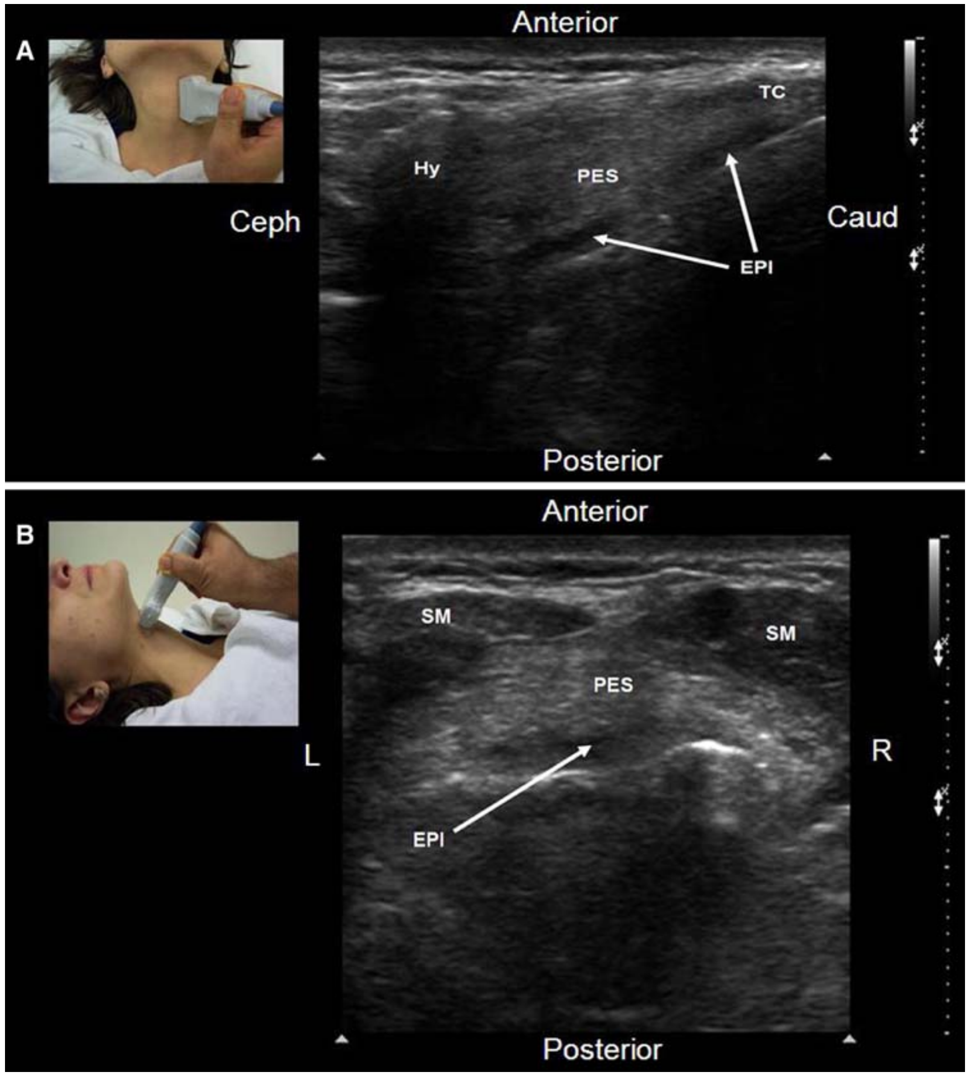

Fig. 1 Transcutaneous sonogram showing the epiglottis and surrounding structures using a linear transducer in **a** left parasagittal and **b** transverse view. Insets show placement of the transducer on skin with the head and neck in sniffing position. The epiglottis is seen as a hypoechoic curvilinear structure at 3–5 cm from the skin. Anteriorly, the triangular hyperechoic area represents the pre-epiglottic space (PES). Posterior hyperechoic linear echoes represent the posterior mucocutaneous surface of the epiglottis due to the formation of the air–mucosa interface. *Ceph* cephalad; *Caud* caudad; *EPI* epiglottis; *Hy* hyoid bone shadow; *PES* pre-epiglottic space; *SM* strap muscle; *TC* thyroid cartilage

Reply

We thank Dr. Prasad *et al.* for sharing their experience using an alternative technique to the sublingual approach for airway sonography which we reported previously in the *Journal*.[1,2] While we applaud their interesting observations, we are not in complete agreement with all of their statements.

Dr. Prasad's group claim that they are able to overcome the difficulties associated with poor probe-skin contact using a transcutaneous approach, while concurrently retaining the ability to capture an image of the epiglottis in both the parasagittal and transverse planes. Through our own clinical experience and ongoing research, it has become evident that the presence of a poor ultrasound medium, such as air, appears as a hyperechoic artifact, which in turn obscures the view of deeper structures. Specifically, a major portion of the epiglottis is suspended in air, with only the caudad portion being in contact with the adipose tissue at the pre-epiglottic space. Intuitively, it should be nearly impossible to obtain a precise ultrasound image of the entire epiglottis (even using an anteroposterior probe orientation) with a transcutaneous approach. Keeping this in mind, the reason for difficulty in capturing images of the epiglottis is not simply "due to posterior acoustic shadowing of the hyoid bone" as Dr. Prasad's group suggests.

In our view, the figure provided in the letter does not entirely support the authors' claim that the "epiglottis can be visualized above and below the hyoid bone". No clear identification of the epiglottis is illustrated at a level above the hyoid bone. It is also not entirely clear that the hyperechoic linear echoes appearing below the hyoid bone in the image "represent the posterior mucocutaneous surface of the epiglottis due to the formation of the air–mucosa interface". We have found that an approach which analyzes movement or some other surrogate marker (in our example, the anterior movement of the hyoid bone during swallowing)[2] helps to confirm the identity of the various echogenic structures. This approach is also used by other investigators who have identified the vocal cords during respiratory and swallowing movements,[3] or during an inadvertent esophageal intubation with the new appearance of a paratracheal hyperechogenicity.[4] Finally, the reliability of the so-called "air–mucosa interface" to provide a consistent and reasonable ultrasound medium for imaging remains to be established.

In spite of the above concerns, we agree with Dr. Prasad *et al*. that combining the sublingual and transcutaneous scans might highlight the details of the oropharynx and the laryngopharynx, respectively, which may potentially provide complementary views in order to gain a comprehensive evaluation of the airway. It is our hope that future research in this area will demonstrate the merits of either or both techniques in airway assessment and management. Nevertheless, we must emphasize our previously expressed view that "ultrasound visualization is indirect, and images are subject to individual interpretation depending on the equipment being used and individual experience and training. Instead of attempting to identify the target structure as the initial step in ultrasound imaging, one should first review the relevant anatomy of the region being imaged and consider the physics of the ultrasound beam."[2]

Funding Funding support in part by Alberta Heritage Medical Reserach Foundation (AHFMR) Clinical Scholar Investigator Award.

Competing interests None declared.

References

1. *Tsui BC, Hui CM*. Sublingual airway ultrasound imaging. Can J Anesth 2008; 55: 790–1.
2. *Tsui BC, Hui CM*. Challenges in sublingual airway ultrasound interpretation. Can J Anesth 2009; 56: 393–4.
3. *Lakhal K, Delplace X, Cottier JP, et al*. The feasibility of ultrasound to assess subglottic diameter. Anesth Analg 2007; 104: 611–4.
4. *Werner SL, Smith CE, Goldstein JR, Jones RA, Cydulka RK*. Pilot study to evaluate the accuracy of ultrasonography in confirming endotracheal tube placement. Ann Emerg Med 2007; 49: 75–80.

Ban C. H. Tsui, MD
Carolyn M. W. Hui, MD
University of Alberta Hospital, Edmonton, Canada