Title: ULTRASOUND EXAMINATION OF THE VOCAL CORDS AND LARYNX: A GUIDE TO INTUBATION AND A DIAGNOSTIC AID

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INTRODUCTION: A non-invasive method of visualizing the vocal cords and larynx would be a useful tool in the management of difficult intubations and as an aid to the diagnosis of vocal cord abnormalities. Real-time ultrasound is a technique capable of high resolution imaging. Therefore, we tested the ability of ultrasound imaging of laryngeal structures to guide endotracheal intubation and to diagnose vocal cord abnormalities, non-invasively.

METHODS: Institutional approval and informed consent were obtained. A real-time portable ultrasound scanner was used (Acuson Corp., Mountain View, CA) with a linear phased array transducer probe (5 MHz). The patients were supine and the neck was hyperextended for the examinations. To obtain transverse views, the transducer was positioned above the thyroid notch and scanning was continued to the middle of the thyroid cartilage. Longitudinal and coronal views of the larynx were also obtained. All examinations were conducted in real-time. In order to enhance ultrasound visualization of the endotracheal tube, a Fogarty catheter was placed into the lumen of a 9.0 Shiley endotracheal tube and the catheter balloon was inflated with saline prior to endotracheal intubations.

RESULTS: Ten healthy adult volunteers and five full term newborn infants without apparent laryngeal pathology were successfully scanned. The false vocal cords appeared as paired hyperechoic structures and the true vocal cords appeared as paired hypoechoic structures (Fig.1). The symmetrical abduction/adduction of both the true and false vocal cords was easily observed on real-time ultrasound, using a transverse view. However, imaging of six preterm neonates (<1000 g) proved unsatisfactory. Four adult patients undergoing direct laryngoscopy, to evaluate suspected vocal cord lesions, were also scanned. Ultrasound scanning demonstrated the presence of vocal cord paralysis seen on direct laryngoscopic examination.

We next attempted to use the real-time ultrasound image of the vocal cords and larynx to guide the endotracheal intubation of an awake, healthy volunteer (HC). Following topicalization of the larynx with 4% lidocaine, an ultrasound image of the larynx was obtained and the endotracheal tube was advanced blindly into the oropharynx until the saline filled cuff was visualized on the ultrasound. The endotracheal tube was then advanced into the trachea using the ultrasound image as a guide (Fig. 2). However, additional attempts using ultrasound guided endotracheal intubation in three anesthetized patients proved unsuccessful as a result of difficulty adequately visualizing the tip of the advancing endotracheal tube. This is a result of scattering of the ultrasound beam by the tracheal air column. These three patients were easily intubated following direct laryngoscopy.

DISCUSSION: The present study demonstrates that high resolution ultrasonography is capable of producing good quality images of the vocal cords and larynx. However, further refinements in this technique are needed before ultrasound will be a clinically useful aid to endotracheal intubation. At the present time, vocal cord movement can be adequately assessed during real-time examination. Ultrasound may prove to be a clinically useful tool to non-invasively examine the vocal cords and larynx.

FIGURE 1. Laryngeal transverse sonogram in a 35 year old woman, Fe, false vocal cords; Th, thyroid cartilage; tr, trachea.

FIGURE 2. Laryngeal sagittal sonogram in a 34 year old man during oral ultrasound guided endotracheal intubation. Et, endotracheal tube; l, laryngeal inlet; tr, trachea.