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Editorial

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Ultrasound Imaging in Airway Management: A Boon?

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Airway management is the basic skill acquired and mastered by anesthesiologist and is their prime responsibility. Difficulties in optimal airway management can lead to serious adverse effects and failure can even lead to mortality. Due to these reasons, diligent efforts are continuously being undertaken to improve the care in form of introduction of various guidelines, audits, safe monitoring standards and newer airway gadgets. Conventional imaging includes x-rays, computed tomography (CT) or Magnetic resonance imaging (MRI). However these have risk of radiations hazards and do not provide real time imaging required during airway management. Ultrasound (US) is one such relatively recent adjunct to anaesthesiologist's armentarium. Since its inception in airway management, the list of applications of ultrasonography in perioperative, emergency and critical care settings is increasing exponentially. Its advantages include safety, simplicity, portability, non-invasiveness, cost effectiveness and reproducibility. Ample literature now exists to support its utility as well as efficacy.

Sound knowledge of the basic physics in relation to US, regional sono-anatomy and proper transducer selection is important to gain maximum advantage of the technique. Standard 7.5 MHz linear probe for visualisation of superficial structures and 5 MHz curved array probe for deeper structures are used [1]. The image is built from reflected sound signals. Despite the fact that airway is filled with air which is a poor medium for US transmission, the superficial location of airway structures helps in sonographic visualisation. Infact, sonographic images of airway obtained using high frequency linear probe have higher resolution than CT or MRI [2].

US provide dynamic anatomical information. In a study by Erzi et al. [3] for prediction of difficult airway in morbidly obese patients, soft tissue thickness measured using US at the three levels on anterior aspect of trachea along with neck circumference (> 50 cm) was found to correlate with difficult laryngoscopy [3]. In another study conducted in obese patients, authors found that hyomental distance ratio>1.1 on US (ratio of hyomental distance in neutral and hyperextended neck) predicted easy laryngoscopy [4]. Width of tongue base as measured by US and lateral pharyngeal wall thickness has also been found to correlate with the presence of obstructive sleep apnoea [5,6].

US can reliably detect the presence of full stomach by measurement of cross sectional area of gastric antrum [7]. In addition, the nature of gastric contents (clear fluid, thick turbid or solid) can also be assessed [8]. Another very useful application is identification of cricothyroid membrane prior to an anticipated difficult airway management [9]. This can provide an added safety by assisting emergency or elective placement of a transtracheal cricothyrotomy cannula to overcome a 'cannot ventilate cannot intubate' (CVCI) scenario. US can assist in performing superior laryngeal nerve blocks prior to a planned awake intubation [10,11].

Prediction of endotracheal tube size by measuring subglottic diameter is useful application of US particularly in paediatric patients [12]. Prediction of diameter of left main stem bronchus (for placement of double lumen tube) was found to be quite reliable [13]. US guided measurements have shown good correlation with advance imaging techniques like CT and MRI [12,13]. US has also been utilized for determination of tracheal width and distance from the skin for prediction of tracheostomy tube size and shape [14].

Confirmation of endotracheal (ETT) placement is a promising application of US. Real-time visualisation of the endotracheal tube insertion, looking for lung-sliding and diaphragmatic movement bilaterally can help confirm the endotracheal intubation. Esophageal intubation can be reliably detected as a bright hyperechoic curved line on one side of and deeper to trachea [15]. Similarly, endobronchial intubation can be diagnosed by unilateral pleural and diaphragmatic movement. Filling the ETT cuff with fluid can help in locating its position [16]. In children, during real time visualisation of ETT with US, widening of vocal cords is seen as the ETT crosses them [17]. In a study by Adi et al. [18], authors concluded that bedside US to verify endotracheal tube location is feasible and can replace waveform capnography in centres without this facility. Pfeiffer et al. [19] showed that US confirmation of ETT placement is faster than standard method of auscultation with capnography. US confirmation of the ETT placement is potentially useful in noisy environment such as prehospital field situation, where auscultation may be difficult. In addition, in a cardiac arrest and other low cardiac output situation, where end tidal capnometry may not be very reliable, US can be a useful tool.

US can also be used to confirm correct laryngeal mask airway (LMA) placement and rule out causes of inadequate ventilation [20]. LMA cuff (inflated with fluid) should be visualized equally on both sides of larynx for proper seal. Grading of LMA placement thus obtained using US is more convenient as compared to fiberoptic examination with good correlation of the results [20].

US guided percutaneous dilatational tracheostomy (PDT) is increasingly being advocated. It permits visualisation of pretracheal blood vessels and selection of puncture site [21]. It decreases adverse effects related to PDT e.g. cranial misplacement, major haemorrhage, posterior tracheal wall puncture and injury to thyroid isthmus [21-23]. Hypercapnia associated with FOB guided PDT can also be avoided with US guided procedure [24]. Real time visualisation of the needle path and guide wire placement using linear array probe may increase the success with US guided PDT [25].

Post extubation stridor can be reliably predicted in intubated patients by measuring the width of air column after deflating the ETT cuff [26]. An air column width of less than 4.5 ±0.8 mm was found to be associated with stridor. In addition to assessment and intervention, US has found its place in diagnosis of various conditions that can have implication for airway management e.g. vocal cord malfunction, [27] swallowing abnormalities, [28] sialolithiasis, [29] supraglottic hemangiomas, [30] respiratory papillomatosis [31], laryngeal stenosis, [32] Zenker's diverticulum, [33] maxillary sinusitis [34] etc to name a few.

Limitation of sonography like any other skill based technique is that its use is operator dependent and requires initial training to become proficient in its use. Though encouraging evidence exists, it is not robust enough to prompt a change in standard practise at present. At present, US can be viewed as a complement to other monitoring and imaging modalities rather than a replacement. Recent developments in sonography technology like pocket sized smart phone based system can widen the horizon for its application even in remote areas [35].

To conclude, ultrasonography is turning out to be a boon to managers of airway. With better accessibility, familiarity and further improvement in technology, its use in airway management may well become a rule rather than exception in future.

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