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EDITORIAL

# Ultrasound: A promising tool for contemporary airway management

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## Abstract

Airway evaluation and its management remains an ever emerging clinical science. Present airway management tools are static and do not provide dynamic airway management option. Visualized procedures like ultrasound (US) provide point of care real time dynamic views of the airway in perioperative, emergency and critical care settings. US can provide dynamic anatomical assessment which is not possible by clinical examination alone. US aids in detecting gastric contents and the nature of gastric contents (clear fluid, thick turbid or solid) as well. US can help in predicting endotracheal tube size by measuring subglottic diameter and diameter of left main stem bronchus. US was found to be a sensitive in detecting rotational malposition of LMA in children. Also, US is the fastest and highly sensitive tool to rule out a suspected intraoperative pneumothorax. In intensive care units, US helps torule out causes of inadequate ventilation, determine the tracheal width and distance from the skin to predict tracheotomy tube size and shape and assist with percutaneous dilatational tracheostomy. US can help in confirming the correct tracheal tube placement by dynamic visualisation of the endotracheal tube insertion, widening of vocal cords (children), and bilateral lung-sliding and diaphragmatic movement. Thus, ultrasonography has brought a paradigm shift in the practise of airway management. With increasing awareness, portability, accessibility and further sophistication in technology, it is likely to find a place in routine airway management. We are not far from the time when all of us will be carrying a pocket US machine like stethoscopes to corroborate our clinical findings at point of care.

**Key words:** Airway; Ultrasound; Evaluation; Difficult; Management



**Core tip:** Airway evaluation and its' management is conventionally based on clinical examination and

radiological imaging. They remain static and do not provide dynamic airway management option. Visualized procedures like ultrasound (US) provide point of care real time dynamic views of the airway in perioperative, emergency and critical care settings. US also aids in detecting gastric contents and the nature of gastric contents (clear fluid, thick turbid or solid). This detection is important for preventing complication of aspiration during airway management. The ultrasonography has brought a paradigm shift in the practise of airway management. With increasing awareness, portability, accessibility and further sophistication in technology, it is likely to find a place in routine airway management. We are not far from the time when all of us will be carrying a pocket US machine like stethoscopes to corroborate our clinical findings at point of care.

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Contemporary anaesthesia practise is richly blessed with technology based solutions. Technology has served to reduce human error in enumerable ways. Ultrasonography is one such extremely useful tool which is finding increasing applications in anaesthesia. It is already being considered as "gold standard" for central venous cannulations and peripheral nerve blockade. Visualized procedures improve safety and outcomes as compared to conventional techniques. In recent past, accumulated evidence is favouring its utility for various aspects of airway management for preoperative airway assessment, intraoperative management, predicting weaning from ventilation and successful extubation[1-3]. Various closed claim database and national level audits continue to implicate failure in airway management as a major contributor to perioperative morbidity and mortality[4-6]. Hence, constant efforts have been directed towards finding a "fail-safe" device for assisting us with airway management. Ultrasound (US) is turning out to be one such promising tool.

US provides point of care real time dynamic views of the airway inperioperative, emergency and critical care settings. It is free of ionizing radiation, painless, portable, convenient, reproducible, accurate and easily mastered skill and anaesthesiologist need not be dependent on their radiology colleagues. Because of superficial location of larynx, US can provide images of even higher resolution than advanced imaging modalities like computed tomography (CT) or magnetic resonance imaging (MRI)[6].

Conventional airway assessment fails predict difficult intubation in all patients. US can provide dynamic anatomicalassessment which is not possible by clinical examination alone. Various studies have suggested that US can help in predicting difficult airway by measuring the soft tissue thickness measured on anterior aspect of trachea along with neck circumference[1], hyomental distance ratio[7], width of tongue base and lateral pharyngeal wall thickness[8]. Intraoral sublingual approach to US is being investigated as a useful approach to predict difficult airway[9]. If difficult airway is suspected US can assist in preparing the airway (superior laryngeal and recurrent laryngeal) for awake intubation[10] and identify the cricothyroid membrane so that transtracheal cricothyrotomy cannula can be placed in a "cannot ventilate cannot intubate" (CVCI) scenario[11,12]. Though fasting guidelines are well known, however, gastric emptying is quite variable. US aids in detecting gastric contents and thenature of gastric contents (clear fluid, thick turbid or solid) as well[13].

US can help in predicting endotracheal tube size by measuring subglottic diameter and diameter of left main stem bronchus (for placement of double lumen tube) and help in deciding the appropriate size of the endotracheal tube (ETT)[14,15]. US can also be used to confirm correct laryngeal mask airway (LMA) placement[16]. Its use instead of fiberoptic confirmation averts the hypercapnia associated with the later[17]. US was found to be a sensitive in detecting rotational malposition of LMA in children[18]. Also, US is the fastest and highly sensitive tool to rule out a suspected intraoperative pneumothorax[2].

In intensive care units, US helps to rule out causes of inadequate ventilation, determine the tracheal width and distance from the skin to predict tracheotomy tube size and shape and assist with percutaneous dilatational tracheostomy (PDT)[19,20]. US guided PDT provides real time visualisation of the needle path and guide wire placement using linear array probe. It permits visualisation of pretracheal blood vessels, selection of puncture site, decreases posterior tracheal wall puncture, decreases injury to thyroid isthmus and increases the overall success[21-23]. US has been found to be a better alternative to FOB guided PDT and may replace it in coming years.

US scan help in confirming the correct tracheal ETT placement by dynamic visualisation of the ETT tube insertion, widening of vocal cords (children), and bilateral lung-sliding and diaphragmatic movement[23-25]. Additional advantage of US guided ETT placement is that esophageal intubation can be diagnosed prior to initiation of mechanical ventilation, thus reducing gastric insufflations and its consequences. Recent studies have suggested that bedside US is feasible and faster substitute to conventional techniques (auscultation and waveform capnography) and may replace them in future[24].

Expanding literature in recent years is indicating the utility of US in diagnosing various pathologies that can have implication in clinical decision making, *e.g.*, vocal cord malfunction[3], swallowing abnormalities[25], sialolithiasis[26], supraglottic hemangiomas[27], respi-

ratory papillomatosis[28], laryngeal stenosis[29], Zenker's diverticulum[30-34], *etc*.

Recent advances in airway US include transesophageal US which can provide distal airway images from mid-trachea to bronchi[33]. Additionally, endoscopic high frequency US of larynx has been described where a thin catheter high frequency probe with rotating mirror can produce 360° image of larynx[34]. With advent of multiplanar 3D US in airway imaging, spectrum of its application has further widened as spatial information obtained is more detailed and measurements obtained are more precise[35]. A recent report describing the use of 3D US concluded that airway anatomy, anteroposterior diameter of subglottic area and transverse diameter of upper trachea can be accurately measured and correlated with MRI findings[35]. Pocket sized smartphone based system can increase its applicability even in remote areas[36].

US has steep learning curve as depicted by many studies[37]. Inexpensive training models like gel phantom model can help improve US assessment and interventional skills and safety[38]. However, like and any other skill based technique, a degree of manual dexterity and knowledge is required to be proficient in its use. Hence, its accuracy remains operator dependent.

To conclude, ultrasonography has brought a paradigm shift in the practise of airway management. With increasing awareness, portability, accessibility and further sophistication in technology, it is likely to find a place in routine airway management. We are not far from the time when all of us will be carrying a pocket US machine like stethoscopes to corroborate our clinical findings at point of care.

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