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# Temporal comparison of real-time ultrasound vs auscultation in confirmation of Endotracheal tube placement

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**Conflicts of Interest:** Nil

## Abstract

**Background:** Temporal comparison of real-time ultrasound vs auscultation in confirmation of endotracheal tube placement

**Methods:** Prospective Observational conducted at Department of Anesthesiology, Dr. RPGMC Kangra at Tanda, Himachal Pradesh

**Results:** Time taken by Auscultation in seconds for confirmation of endotracheal intubation was significantly different (P=0.000) in grade 1 (36.31±.577), grade 2 (36.65±.607), grade 3 (40.24±.902), and grade 4 (41.67±.866)

**Conclusion:** Ultrasound is better and fast than auscultation in confirmation of endotracheal tube placement

**Keywords:** Ultrasound, endotracheal intubation, direct laryngoscopy

## Introduction

There is an increasing focus on the utility of ultrasound in airway management and accordingly, The American College of Emergency Physicians recently published a policy statement on the verification of endotracheal intubation mentioning ultrasound as a possible future adjunct. Ultrasound can confirm endotracheal intubation in a number of ways. By scanning at the level of the cricoid membrane, direct visualization of the passage of the endotracheal tube through the vocal chords is possible. By scanning of the anterior neck at the level of the suprasternal notch, the absence of oesophageal shadowing in the paratracheal tissue following intubation indicate endotracheal tube placement.[1]

Real-time visualization of endotracheal tube placement may be possibleby transtracheal scanning just below the cricoid ring.9,10 Finally, during post-intubation, bag ventilation diaphragmatic excursions visualized by two-dimensional ultrasound or the identification of specific dynamic ultrasonographic signs in the pleural interface known as lung sliding has been shown to be both sensitive and specific for lung ventilation and thus endotracheal tube position.[2-5] In this context, the absence of lung sliding over one lung may indicate main stem intubation or pneumothorax, and absence over both lungs could indicate either oesophageal intubation or cuff leakage.[6]

## Material and Methods

**Type of Study:** Prospective Observational

**Place of Study:** Department of Anesthesiology, Dr. RPGMC Kangra at Tanda, Himachal Pradesh

**Study Population:** After approval by institutional ethics committee and obtaining informed consent, prospective and observational study was carried out over the period of one year.

**Inclusion criteria**

1. Males and females between the age group 18-60 years.
2. ASA physical class I-II.
3. BMI 18.5-29.9.

**Exclusion criteria**

1. Patient's refusal to participate in the study
2. Rapid-sequence induction of anesthesia
3. Inability to open the mouth due to existing trauma or medical condition, preexisting neck or facial disease-causing distortion of the airway, edentulous, and/or a history of difficult intubation
4. Altered level of consciousness, confusion, or inability to follow commands
5. Preexisting limitation or pain with cervical spine movement. Patients requiring rapid-sequence induction are already at high risk for aspiration; the airway should be rapidly secured with an endotracheal tube and not subjected to repeated or delayed assessment as might occur in the study. Blinding

The interpreter reliability was double-blinded, that is, the anesthesiologist assessing glottic exposure and the investigator recording the observations were blinded to the preoperative sonographic airway assessment results.

**Methodology**

The enrolled patients underwent sonographic assessment of airway by the anesthesiologist in the preoperative holding area. The ultrasound view of the airway of all study patients was assessed with a highfrequency linear probe or low frequency curved probe (SonoSite® MicroMaxx® ultrasound system (SonoSite INC, Bothell, WA). The following measurements were obtained with the patient in supine position and head and neck in a neutral position:

1. A curved low-frequency (5-MHz) transducer was used to visualize the tongue and shadows of the hyoid bone and mandible. The mentum and hyoid bone appear in midsagittal scans as hyperechoic structures with hypoechoic shadowing. The hyomental distances in the neutral and head-extended positions were measured from the upper border of the hyoid bone to the lower border of the mentum in the neutral and extended head positions.
2. The thicknesses of anterior neck soft tissue at the hyoid bone and the thyrohyoid membrane were obtained transversely across the anterior surface of the neck with a 13–6 MHz linear array ultrasound probe attached to a SonoSite S-nerve machine (SonoSite Inc., Bothell, WA, USA). At hyoid bone level, the minimal distance from the hyoid bone to the skin surface (DSHB) was measured and at thyrohyoid membrane level, the distance from skin to epiglottis midway (DSEM) between the hyoid bone and thyroid cartilage was measured.
3. The following measurements were obtained with the oblique-transverse ultrasound view of the airway: (a) the distance from the epiglottis to the midpoint of the distance between the vocal folds, (b) the depth of the pre-epiglottic space After intravenous induction with midazolam 0.04 mg/kg, propofol 2–2.5 mg/kg, fentanyl 2μg/kg, and atracuriumbesylate 0.5 mg/kg, endotracheal intubation was carried out by anesthesia providers with a minimum of 2 years experience in endotracheal intubation with the patient in a neutral position without neck overextension or over-bending. The Macintosh blades were used to expose the target larynx, and no external laryngeal pressure was used to facilitate this process. Classification of laryngoscopic views was based on the method described by Cormack and Lehane.[2] Grade I is full view of the glottis. Grade II is a partial view of

the glottis or arytenoids. Grade III is the only epiglottis seen. Grade IV is neither glottis nor epiglottis visible. Grade I and II are categorized as easy laryngoscopy. Grade III or IV are categorized as difficult laryngoscopy.

Real-time tracheal ultrasonography was performed during the intubation with the transducer placed transversely just above the suprasternal notch, to assess for endotracheal tube positioning and exclude esophageal intubation. The position of trachea was identified by a hyperechoic air-mucosa (A-M) interface with posterior reverberation artifact (comet-tail artifact). The endotracheal tube position was considered as endotracheal if single A-M interface with comet-tail artifact was observed. Endotracheal tube position was defined as intra-esophageal if a second AM interface appeared, suggesting a false second airway (double tract sign).

A standard protocol was followed for auscultation with the investigator first auscultating over the epigastrium, then in the right and left lung in that order. Unchanged ETCO2 levels and capnography after six ventilations were regarded as final proof of endotracheal intubation. Time measurement was started when the laryngoscope blade was introduced into the mouth to confirmation of the tube placement by sonographically, auscultation and capnography.

Statistical analysis: Data were presented as frequency, percentages or mean ± SD, wherever applicable. Categorical variables between the groups were compared using Chi-square test. Quantitative variables between the groups were compared using student t-test. A P values less than 0.05 considered significant. Statistical analyses were performed using SPSS trial version 21

**Results**

The present study was aimed to preoperative assess airway by the point of care USG in patients undergoing surgery under general anesthesia. The prospective observational study was conducted for a period of one year in Department of Anesthesiology, Dr. RPGMC, Kangra at Tanda, Himachal Pradesh. A total of 200 patients were included in the study after they fulfilled inclusion criteria.

The patients' age ranged from 18 to 60 years with a mean age of 41.68 years. Majority of the patients (28%) were in 31-40 year age-group followed by 51-60 years (27%), 21-30 years (22.5%), and 41-50 years (21%)

Table 1: General Characteristics

| | Cormack Lehane Grading (n=200) | | | | P Value |
|---|---|---|---|---|---|
| | Easy (n=142) | | Difficult (n=58) | | |
| | Grade 1 (n=54) | Grade 2 (n=88) | Grade 3 (n=49) | Grade 4 (n=9) | |
| Age (years) | 36.96±11.0 | 41.70±13.5 | 45.51±12.3 | 48.89±10.08 | $P^{1234}$=0.002<br>$P^{13}$= 0.004<br>$P^{14}$=0.042 |
| Height | 64.35±2.30 | 63.95±2.05 | 64.51±2.10 | 64.78±2.5 | P=0.392 |
| Weight (Kg) | 54.63±8.36 | 54.94±8.87 | 59.61±8.233 | 61.44±10.9 | $P^{1234}$=0.003<br>$P^{13}$= 0.021<br>$P^{23}$=0.015 |
| BMI | 21.07±3.07 | 21.52±3.13 | 23.03±2.3 | 23.31±3.36 | $P^{1234}$=0.002<br>$P^{13}$= 0.005<br>$P^{23}$=0.024 |

Table 2: Comparison of Different variables in different grades

| | Cormack Lehane Grading (n=200) | | | | P Value |
|---|---|---|---|---|---|
| | Easy (n=142) | | Difficult (n=58) | | |
| | Grade 1 (n=54) | Grade 2 (n=88) | Grade 3 (n=49) | Grade 4 (n=9) | |
| Time by USG(s) | 29.17±.575 | 29.56±.564 | 32.65±1.032 | 33.78±1.202 | $P^{1234}$=0.000 |
| Time by Auscultation(s) | 36.31±.577 | 36.65±.607 | 40.24±.902 | 41.67±.866 | $P^{1234}$=0.000 |

Time taken by Auscultation in seconds for confirmation of endotracheal intubation was significantly different (P=0.000) in grade 1 (36.31±.577), grade 2 (36.65±.607), grade 3 (40.24±.902), and grade 4 (41.67±.866)

**Discussion**

There have been number of clinical methods and technical aids which have been described to confirm the endotracheal intubation. End-tidalcapnography and auscultation remain the most used technical aids to confirm the endotracheal intubation. Viewing the tube passing between the cords during direct laryngoscopy and visualization of the tracheal rings and carina with a fiberoptic scope after intubation is the only full proof methods of confirming tracheal intubation.

Time taken by Auscultation in seconds for confirmation of endotracheal intubation was significantly different (P=0.000) in grade 1 (36.31±.577), grade 2 (36.65±.607), grade 3 (40.24±.902), and grade 4 (41.67±.866)

In a similar study done by Thomas et al to find the effectiveness of tracheal ultrasonography to confirm ETT placement with the existing methods. It was concluded that Ultrasonography, end-tidal capnography, and conventional clinical methods have comparable sensitivity and specificity in identifying the tracheal or esophageal position of ETT. The time taken to confirm tube placement with ultrasonography was 8.27 ± 1.54 s compared to waveform capnography and clinical methods which were 18.06 ± 2.58 and 20.72 ± 3.21 s, respectively. The time taken by ultrasonography was significantly less. Hence, ultrasonography detected the tube placement faster than the other two methods. The difference between results can be due to the reason that in the study by Thomas et al the time measurement was started when the person who did the intubation confirmed the completion of intubation while in the present study time measurement was started after the introduction of laryngoscopic blade in the mouth.[6-8]

Concluson

Ultrasound is better and fast than auscultation in confirmation of endotracheal tube placement

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