Comparison of Airtraq and Trueview EVO2 with Macintosh Laryngoscope for Endotracheal Intubation by Experienced Anaesthesiologists: A Controlled Clinical Trial

Abstract

Background: The purpose of the study was to evaluate the efficacy of two new laryngoscopes by experienced anaesthesiologists. Airtraq and Truview EVO2 were compared with gold standard Macintosh laryngoscope for endotracheal intubation of elective surgical patients with normal airway distribution.

Methods: In prospective, randomised and controlled manner 150 patients of either sex above 18 yrs, presenting for elective surgery were randomly allocated in three equal groups. Endotracheal intubation was done using either Macintosh (group ML), Airtraq (group AQ) or Trueview (group TL) laryngoscope. Laryngoscopic view of glottis (Cormac and Lehane grade), time taken for intubation, subjective assessment for ease of intubation, intubation difficulty scale (IDS) score as well as attempts for successful intubation, success rate and soft tissue injury during laryngoscopy and intubation were compared.

Results: All the patients intubated with Airtraq and Trueview had Cormack and Lehane grade I or II and none had grade III in comparison with 42 (84%) having grade I or II and 8(16%) having grade III (p<0.05). Mean time taken for intubation was significantly longer with Truview (35.3±11.5 sec) and comparable between Airtraq (19.2±4.7 sec) and Macintosh (24.4±13.8 sec) (p<0.05). On subjective assessment Truview was rated as most difficult device to use for intubation amongst three laryngoscopes. Truview and Airtraq had mean IDS scores of <1 (0.75± 0.4 and 0.56± 0.5 respectively) while a higher score (1.76±2) was found with Macintosh (p<0.05). No significant difference was noted in terms of attempts at intubation, success rate and soft tissue injury.

Conclusion: We concluded that Airtraq was a promising and reliable alternative to Macintosh for endotracheal intubation of patients with normal airway characteristics in experienced hands. Although Trueview provided better intubating conditions than Macintosh, it took longer time for intubation and on subjective assessment, it was graded as difficult to use.

Keywords: Tracheal intubation; Macintosh laryngoscope; Truview EVO2 laryngoscope; Airtraq

Introduction

Laryngoscopy and tracheal intubation require lots of clinical experience to master and is a core skill for all anaesthetists. Despite use of Macintosh laryngoscope for decades, failure to successfully intubate the patient remains the leading cause of morbidity and mortality in operating rooms. Consequently a number of other devices that facilitate endotracheal intubation with low failure rate have been added to the armamentarium of the anaesthesiologists which may replace the conventional direct laryngoscope. Previous manikin trial[1] indicate towards better intubating conditions with most of the new indirect optical laryngoscopes when compared to direct laryngoscopy using Macintosh. But, the results of these studies cannot be extrapolated to clinical scenarios due to use of rigid plastics, the lack of collapsible soft tissues and absence of secretions in the manikin.

Airtraq (Prodol Meditec, Vizcaya, Spain, 2005) is a novel optical laryngoscope with series of lenses, mirrors and an exaggerated blade curvature which provides glottis display without any deviation in normal position of oral, pharyngeal or tracheal axes and allows intubation with minimal manipulation of neck. The tracheal tube does not obstruct the view during intubation [2]. Truview EVO2 laryngoscope (Truphatek International®, Israel) provides unmagnified anterior refraction of 42 degrees in the line of sight with minimal manipulation of the head, neck, instrument or soft tissue [3].

Based on previous clinical [3,4], manikin [1] trials and meta-analysis [2], we hypothesized that Airtraq and Truview Laryngoscope would perform better for airway management of surgical patients with normal airway data. The present study was planned to evaluate the usefulness of Airtraq and Truview by experienced users in patients with low risk of difficult airway.
The new devices were compared with conventional Macintosh laryngoscope. The primary outcome measures were Cormack and Lehane grade and intubation difficulty scale (IDS) score whereas secondary measures were time to successfully intubate and success rate, subjective difficulty in intubation and complications with each device.

**Material & Methods**

The study was conducted after approval from Institutional Review Board and written and informed consent of patients. 150 ASA physical status I–II patients, aged 18 years of age or older, of either sex, scheduled for elective surgical procedures requiring tracheal intubation were recruited in this prospective randomized study. Exclusion criteria were patients with risk of pulmonary aspiration, undergoing emergency surgery and those with anticipated difficult airway (Mallapati grade IV, thyromental distance< 6 cm, mouth opening < 1.5 cm, body mask index> 35 kg/m²). Preoperative airway evaluation was performed by an anaesthetist a day prior to surgery, who was not involved in subsequent anaesthetic management.

Eight hours of fasting was advised and premedication with oral alprazolam 0.25-0.5 mg was given a night before surgery and in the morning of surgery. After shifting the patient to OR, intravenous access was secured and monitors including SpO₂, NIBP, ECG, capnography were applied and baseline parameters recorded. All patients received a standardized general anaesthetic. Prior to induction all patients were premedicated with glycopyrrolate 0.2mg, midazolam 1mg, fentanyl 2 micro grams/kg. After preoxygenation, sleep dose of propofol 2-3mg/kg was titrated to induce anaesthesia followed by vecuronium 0.1 mg/kg intravenously. Three minutes after vecuronium trachea was intubated (after confirming adequacy of neuromuscular block by peripheral nerve stimulator) with a 7.5 gauge ETT in females and 8.5 gauge in males using the laryngoscope depending upon anticipated secretions.

Intubation was more than 120 seconds, it was assigned as failed and intubation was carried by alternate laryngoscope. A semi-rigid stylet was used to assist intubation if needed during laryngoscopy with Macintosh laryngoscope. After completion of intubation the anaesthesiologist judged ease of intubation on the subjective basis as easy, difficult or very difficult and also recorded Intubation Difficulty scale (IDS) score based on variables given in Table 1.

**Statistical Analysis**

We based our sample size estimation on our primary outcome measures namely IDS score and Cormack and Lehane grading. On the basis of a pilot study of 45 patients we considered that a reduction in mean IDS score of 1.5 and standard deviation of 2 from Macintosh group would be clinically important. Using α = 0.05 and β = 0.2, we estimated that minimum 50 patients would be required in each group. Patients' demographic, airway assessment and in the morning of surgery. After shifting the patient to OR, intravenous access was secured and monitors including SpO₂, NIBP, ECG, capnography were applied and baseline parameters recorded. All patients received a standardized general anaesthetic. Prior to induction all patients were premedicated with glycopyrrolate 0.2mg, midazolam 1mg, fentanyl 2 micro grams/kg. After preoxygenation, sleep dose of propofol 2-3mg/kg was titrated to induce anaesthesia followed by vecuronium 0.1 mg/kg intravenously. Three minutes after vecuronium trachea was intubated (after confirming adequacy of neuromuscular block by peripheral nerve stimulator) with a 7.5 gauge ETT in females and 8.5 gauge in males using the laryngoscope depending upon anticipated secretions.

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**Results**

There were no differences in demographic and airway variables (Table 2). Total 150 patients were recruited and there was no failure in intubation in any group. Overall success rate for intubation was not different among the three devices (Table 3) although first attempt success rate was higher in AQ and ML groups. However, a greater number of optimization manoeuvres were required to facilitate tracheal intubation in ML group compared to other two groups (Table 3). Grade I Cormack and Lehane glottis view was obtained in 45(90%) and 43(86%) of patients intubated with Airtraq and Truview laryngoscopes respectively compared to 35 (70%) with Macintosh. In ML group a greater percentage of patients had Cormack and Lehane grade III (16%) in comparison with none in AQ and TL groups (Table 3) (p < 0.05).

Time taken for intubation (TTI) was longest in patients intubated with Truview (35.3±11.5sec) followed by those intubated with Macintosh (24.4±13.8 sec) and Airtraq (19.2±4.7 sec) (Table 3). On statistical comparison TTI was significantly longer in group TL compared with groups AQ and ML (p < 0.05). While assessing the ease of intubation by subjective evaluation, anaesthesiologists found intubation as easy in 70, 71 and 33% of patients in groups AQ, ML and TL respectively (p < 0.01). Mean IDS...
score was 0.56±0.4 in group AQ, 0.75±0.5 in group TL and 1.76±2 in group ML (p<0.05). Significantly more patients in study groups AQ and TL had IDS score of <1 compared to group ML (Table 3). There were no between-group differences in the incidence of complications including minor laceration of lips or blood on laryngoscope blade or dental trauma. Arterial desaturation was not seen in any patient.

**Table 1: Intubation Difficulty Scale (IDS) Score.**

| Parameter                                      | Score  |
|------------------------------------------------|--------|
| Number (n) of attempts at intubation           | n-1    |
| Number (n) of operators attempting intubation  | n-1    |
| Number of alternative intubation techniques    | n-1    |
| Cormack and Lehane grade                       | Grade-1|
| Lifting force required at laryngoscopy         | 0=normal, 1=increased |
| Necessity for External laryngeal pressure      | 0=not applied, 1=applied |
| Position of vocal cords at intubation          | 0-abduction/visualized, 1-adduction |

IDS=Sum of all 7 parameters [IDS=0 (Easy intubation), IDS=1-5 (moderate difficulty), IDS=6-15 (very difficult to impossible)].

**Table 2: Demographic and Airway Data.**

| Variable                                | Group-AQ | Group-TL | Group-ML |
|-----------------------------------------|----------|----------|----------|
| Age (yrs)                               | 38.8     | 36.33    | 39.55    |
| Mean (SD)                               | -10.91   | -11.79   | -13.03   |
| Height (mts)                            | 1.63     | 1.62     | 1.63     |
| Mean (SD)                               | -0.1     | -0.08    | -0.09    |
| Weight (kg)                             | 63.38    | 63.06    | 62.41    |
| Mean (SD)                               | -10.31   | -9.88    | -10.19   |
| Sex M/F                                 | 30/20    | 29/21    | 28/22    |
| Body mass index (kg/m²)                 | 28.2±3.7 | 27.8±4.7 | 27.7±6.4 |
| Mouth Opening (cm)                      | 4.38±0.26| 4.35±0.21| 4.33±0.28|
| Thyromental Distance (cm)               | 6.9±0.24 | 6.99±0.19| 6.98±0.14|
| Mallampati grade 1/2/3/4                | 24/17/9/0| 25/18/7/0| 27/17/6/0|

**Table 3: Study Data for Intubation Attempts.**

| Parameter assessed                     | Group AQ | Group TL | Group ML |
|----------------------------------------|----------|----------|----------|
| IDS Score (Mean±SD)                    | 0.56±0.4* | 0.75±0.5* | 1.76±2   |
| IDS Score (no & %)                     |          |          |          |
| 0                                      | 42 (84%) | 39(78%)  | 26(52%)  |
| 1                                      | 8(16%)   | 9(18%)   | 14(28%)  |
| >1                                     | 0 (0%)   | 2(4%)    | 10 (20%) |
| Cormack & Lehane grade (1/2/3)         | 45/5/0*  | 43/7/0*  | 35/7/8   |
| Optimization manoeuvres (No) 0/1/2     | 46/4/0*  | 43/6/1*  | 34/10/6  |
| Time taken for intubation (Sec) (Mean±SD)| 19.2±4.8** | 35.3±11.5 | 24.4±3.9** |
| Subjective evaluation of intubation (Easy/Difficult/Very difficult) | 39/10/1** | 16/22/12 | 36/11/3** |
| Overall success rate                   | 100%     | 100%     | 100%     |
| Number of attempts 1/2/3/failure       | 42/8/0/0 | 36/12/2/0| 34/9/7/0 |

*significant in relation to group ML
**significant in relation to group TL
Discussion

Inspite of introduction of variety of laryngoscopes, Macintosh laryngoscope still remains the most frequently used intubation aid although it requires alignment of various axes which is a difficult skill to learn, acquire [6] and maintain [7]. Recent alternatives to Macintosh laryngoscope provide magnified/anterior refracted view of glottis without need for alignment of axis. We evaluated newer devices against present ‘gold standard’ as recommended by Cook[8]. Experienced anaesthesiologists conducted the trial in patients with low risk of difficult intubation because new devices require expertise in such patients before use in high risk patients.

Our study demonstrated that overall success rate of intubation was high in all the three groups but first attempt success rate was significantly higher in patients intubated with Airtraq or Macintosh. TTI was shortest in group AQ and longest in group TL with that in group ML lying between these two. While overall IDS scores were lower in all the groups, both mean score and number of patients with IDS score of ≥1were very few in study groups AQ and TL in comparison to group ML. On laryngoscopy, Cormack and Lehane grade was I or II in most patients in each group with no patient of grade III in groups AQ and TL compared to three in group ML. Optimization manoeuvres were more frequently required in group ML. incidence of dental trauma or soft tissue injury was infrequently seen in all the groups.

The method obtained on laryngoscopy is a major factor in determining difficulty of intubation [9] Many clinical and manikin trials conducted till date have taken glottic view as the most important parameter for comparing new laryngoscopic devices [3,5,9]. A unique combination of an extremely curved blade and an inbuilt optical system enables Airtraq to provide a panoramic view of glottis making laryngoscopy easy [10]. Similarly, a 42 degree anterior refracted glottic view with Trueview reduces the difficulties encountered during direct laryngoscopy. This may be a reason why a greater number of patients intubated with Airtraq and Truvie had Cormac and Lehane grade I (45/50 and 43/50 in groups AQ and TL respectively) and none had grade III. Whilst those intubated with Macintosh 35/50 patients had Cormac and Lehane grade I and eight patients grade III. Other studies also reported similar results [11,12]. More patients (16/50) required additional manoeuvres to improve glottis view in group ML. While overall IDS scores were lower in all the groups, both mean score and number of patients with IDS score of ≥1 were very few in study groups AQ and TL in comparison to group ML. On laryngoscopy, Cormac and Lehane grade was I or II in most patients in each group with no patient of grade III in groups AQ and TL compared to three in group ML. Optimization manoeuvres were more frequently required in group ML. incidence of dental trauma or soft tissue injury was infrequently seen in all the groups.

The prolonged intubation time with Truvie could possibly be due to considerable difficulty in advancing the endotracheal tube towards the glottis and also due to lack of practice with the new device [6,19,20]. We opine that this difference of few seconds in intubation time is of no clinical relevance in elective patients but may raise concern in emergency situations. A meta analysis [2] reviewing 1000 patients concluded that the mean time taken for intubation with Airtraq was reduced by 14-16 seconds in patients with normal airway and by 22-25 seconds with difficult airway in comparison to Macintosh laryngoscope.

We also subjectively rated the newer intubation devices as easier to use in comparison with conventional and more familiar Macintosh laryngoscope. On subjective assessment anaesthesiologist rated Truvie as difficult device to use for intubation in most patients. Subjective difficulty in using Truvie observed by us and supported by previous studies [3,20,21] can be attributed to the peculiar technique during use of laryngoscope and also camera mounted may feel heavy to operate [21] and need of good hand eye coordination. We assume that the problems related to the intubation can be overcome considerably by more frequent use and practice with the device as evidenced in this study that intubation time consistently reduced as the study advanced.

Macintosh laryngoscope requires steerage of endotracheal tube which is difficult skill to learn in initial stages. Airtraq has a prefixed channel to align the tube towards glottis. In some patients while using Airtraq endotracheal tube struck posteriorly. Attempts to withdraw the Airtraq slightly upward with tube in situ or using a stylet which reduced the distance between the tip of endotracheal tube and scope. [22] helped to overcome the above problem. Success rate of intubation was more than 95% in each group although first attempt success rate was higher in AQ and ML group [12,13]. All three laryngoscopes performed equally well in experienced hands.

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Direct dental trauma and injury to oral tissue has been reported in 6.9% of patients during direct laryngoscopy with conventional laryngoscope [23]. Previous manikin study [23] reported less potential for trauma to teeth and soft tissues with newer airway devices. In this study the incidence of trauma to lip, teeth and upper airway was almost nil.

There are important limitations with regard to our study. First, we acknowledge that the potential for bias exists, as it is impossible to blind the anaesthetist to the device being used. Certain measurements used in this study, such as laryngoscopic grading, are by their nature subjective. Despite this, Cormack and Lehane grading has been used widely in clinical practice, the appropriateness of using this system with indirect laryngoscopy is open to question. We recruited patients with normal airway characteristics, therefore our results cannot be extrapolated for patients with difficult airway. Furthermore, our study was not a crossover trial so we cannot comment on improvement of Cormack and Lehane grade with the new laryngoscopic devices but our study proves that Airtraq and Truview show better laryngoscopic view in comparison to Macintosh. Lastly the laryngoscopes were used by experienced anaesthetists, so results may not be similar for less experienced users.

Conclusion
On the basis of our observations we conclude that Airtraq and Truview laryngoscopes improved Cormack and Lehane grade and had lower IDS scores in comparison to Macintosh. Airtraq was easy to use and needed less time to intubate as with Macintosh compared to Trueview which was a bit difficult to handle and also needed longer time to intubate. Airtraq proved to be a useful device for endotracheal intubation of patients with normal airway in experienced hands but being single use, cost can be a limiting factor in developing countries. Further studies are required for use by novices and less experienced users with substantial number of patients with both easy and difficult airway to strengthen current study. Tracheal tube does not obstruct the view during intubation [2]. Truview EVO2 laryngoscope (Truphatek International®, Israel) provides unmagnified anterior refraction of 42 degrees in the line of sight with minimal manipulation of the head, neck, instrument or soft tissue [3].

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