A randomized controlled trial comparing Macintosh laryngoscope and Airtraq video laryngoscope for endotracheal intubation in patients with thyroid swelling: Competing the convention

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ABSTRACT

Background: Patients with thyroid swelling are anticipated difficult airway due to the anatomical complications associated with it leading to restricted neck movements and distorted laryngeal anatomy. The aim of this randomized prospective study was to compare Macintosh laryngoscope and Airtraq video laryngoscope for endotracheal intubation in patients with thyroid swelling.

Methods: Eighty adult American Society of Anesthesiologist (ASA) grades I-II patients were taken and randomly divided into two groups of 40 patients in each. After induction of general anesthesia, tracheal intubation was done with either of the technique using a flexometallic tube. Time taken for intubation, hemodynamic variations during and after intubation, any optimization maneuver used during intubation, Cormack-Lehane score, Percentage of Glottic Opening (POGO score), Intubation Difficulty Score (IDS), and postoperative airway symptoms were noted.

Results: Mean time required for intubation with Airtraq was more than Macintosh; \( P = 0.003 \). But Cormack-Lehane score, IDS score, and POGO score were better in the Airtraq group. Hemodynamic variations in both groups were comparable. Optimization maneuver required and postoperative airway symptoms were more in the Macintosh group.

Conclusion: In patients with thyroid swelling, Airtraq video laryngoscope provides better visualization of the glottis, requires less manipulation during intubation, and less post-operative complications than Macintosh laryngoscope but requires significantly more time for intubation.

Keywords: Difficult airway, endotracheal intubation, thyroid swelling, video laryngoscope

Introduction

For the anesthesiologist, intubating trachea and securing the airway remains a challenge although it is a routine practice for them. Failure or difficulty in successfully intubating the trachea remains a leading cause of morbidity and mortality in susceptible patients of operating room, wards, and intensive care units.[5] Patients with thyroid swellings are classified as difficult airway. A number of anatomical complications are possible with goiters and results in many implications to the airway. This can lead to laryngomalacia, airway obstruction, lumpy airway, and vascular congestion causing edema that further can compromise the patient’s airway. An enlarged thyroid gland producing tracheal deviation, compression, or both can lead to difficult airway and intubation.[5]
The laryngoscope blade described by Macintosh in 1943 remains the gold standard and continues to be the most widely used device for endotracheal intubation for almost a century. However, in the last three decades a variety of alternative intubation devices have emerged.\(^{[3]}\)

The Airtraq is a laryngoscope that has been developed to aid tracheal intubation in patients with normal or difficult airways. It came into clinical practice in 2005. It was developed by Pedra A. Gandarias, produced and marketed by Prodol Meditec S.A., Vizcaya, Spain.\(^{[4]}\) It is an indirect laryngoscope which has two channels, first of which transfers the image to a proximal eyepiece via a series of prisms and lenses, the other channel acts as a conduit for the endotracheal tube. The blade has an exaggerated curvature which provides a view of the glottis without alignment of oral, pharyngeal and tracheal axes; and a mechanism to prevent fogging of the distal lens.\(^{[1,3]}\)

Keeping in view the difficult airway and intubation due to enlarged thyroid swelling, which can be a life-threatening situation in the operating theatres as well as outside operating theatres, the present study was performed to compare between Macintosh laryngoscope and Airtraq laryngoscope in patients with thyroid swelling which has not been done so far. Such knowledge will help the anaesthesiologists and the primary care physicians to deal with situations of sudden unanticipated difficult airway in these group of patients.

**Materials and Methods**

This study was conducted between August 2017 and July 2018 after getting clearance from the institutional ethics committee (Approval number: 1110/Ethics/R.Cell‑17) and Central Trial Registry (CTRI/2018/03/017984). This research has been conducted in accordance with the ethics standards required by the Declaration of Helsinki issued in 2013. Eighty ASA grade I ‑ II patients between ages of 18 and 60 years of either sex, Mallampati grade 1 or 2 with thyroid neck swelling posted for elective thyroidectomy giving written and informed consent for the study were enrolled. Patients with history of previous neck surgery or difficult intubation in any previous surgery or those with inter‑incisor distance less than 3.5 cm were excluded from the study.

All the patients were randomly divided into two groups based on the laryngoscope to be used. Group A were the patients to be intubated with the use of Airtraq video laryngoscope (AVL) and group M with Macintosh laryngoscope (ML). Randomization was done using computer generated random tables.

All the patients were fasted for solids for at least 6 hrs before the surgery. After taking patients in operation theatre, pulse oximeter, electrocardiogram (ECG) leads, and non‑invasive blood pressure (NIBP) cuff were attached and baseline vitals were recorded. Induction of general anesthesia was done with injection fentanyl 2 µg/kg iv and injection propofol (2-3 mg/kg iv) titrated to induce anesthesia in a dose sufficient to produce loss of verbal response; after checking for bag and mask ventilation, succinylcholine was given at 2 mg/kg iv. After the onset of neuromuscular block, intubation was done with armored endotracheal tube of appropriate size with one of the study devices.

In group A patients, appropriate size of AVL was selected and light was turned on. About 30 sec were required for fixing of light and activation of anti-fogging system. Appropriately sized armored ET tube was taken and gum-elastic bougie was preloaded in its lumen. Cuff of the tube was deflated and lubricated with lignocaine jelly and then placed in the lateral channel of the laryngoscope. AVL was also lubricated before introduction without contacting the lens to aid smooth introduction. The blade was inserted into the mouth over the tongue keeping it in midline. Tip of the laryngoscope was positioned over the vallecula and glottis visualized. The bougie was first progressed into the larynx followed by rail-loading of the tube over it. Tube was then disengaged from the AVL and the device removed. Intubation was then confirmed by capnography.

In patients of group M, ML of proper size was used. After obtaining best possible glottic view, gum-elastic bougie was introduced which was then rail-loaded with armored ET tube of appropriate size. Intubation was confirmed by square wave capnography.

Injection Vecuronium 0.05 mg/kg iv was given subsequently in both groups.

Time taken during laryngoscopy (primary outcome) was noted as the time between insertion of laryngoscope and confirmation of endotracheal intubation by capnometry. In this study, it was divided between the time taken from insertion of laryngoscope to visualization of glottis and the time taken from thereafter till confirmation of endotracheal intubation by square wave capnography.

Quality of glottis viewed in terms of Cormack‑Lehane (CL) score, Percentage of Glottic Opening (POGO) score and Intubation Difficulty score (IDS) were noted. Any intubation requiring time >120 seconds were considered as failed intubation.

Hemodynamic parameters in terms of heart rate (HR) and blood pressure (BP) were noted at time interval of 0, 1, 2, 5, and 10 min of intubation.

Hoarseness, any oral or dental bleeding or injury, laryngeal edema and laryngospasm observed after extubating were recorded.

CL grading was done between grade 1 and 4:
- Grade 1 — visualization of entire vocal cords;
- Grade 2 — visualization of posterior part of the laryngeal aperture;
- Grade 3 — visualization of only epiglottis;
- Grade 4 — no glottic structures or epiglottis seen.
POGO scoring was done between 0 and 100% as:
- 100% – entire glottis aperture is seen;
- 50% – lower half of vocal cords and arytenoids seen;
- 0% – no glottis structures seen.

IDS score is a seven-point scoring system which helps in determining the difficulty of intubation based on several parameters that are:
1. Number of additional attempts
2. Number of additional operators
3. Number of alternative techniques
4. CL Grade
5. Amount of lifting force required
6. Laryngeal Pressure required or not
7. Vocal cord mobility at the time of laryngoscopy.

IDS score is then calculated and inference made from the following: IDS 0 = easy, IDS 1-5 = slight difficulty, IDS >5 = major difficulty in intubation.

The sample size was calculated using the formula proposed by Snedecor and Cochran (1989). 5% margin of error (Type I error: \( \alpha = 0.05 \)) and 80% power (Type II error: \( 1-\beta = 0.80 \)) were taken. Statistical analysis was done using SPSS version 18.0 (SPSS Inc., Chicago, IL, USA) software. Arithmetic mean and standard deviation were used. Chi Square Test was used for testing the association between variables. Unpaired t-test was used to compare the means of two unmatched groups or two independent set of data. The Consort diagram is shown in Figure 1.

**Results**

Both the groups were comparable in terms of age, sex distribution, weight, and ASA physical status [Table 1]. 50% of patients in both the groups were of MPG grade 1 and rest 50% were of MPG grade 2. Both the groups were comparable in terms of findings of X-ray neck in antero-posterior and lateral view.

The time taken from insertion of laryngoscope blade to visualization of glottis was less in group A (11.75 ± 3.34 sec) than in group M (17.64 ± 12.54 sec) \( (P = 0.005) \) but the time from visualization of glottis to the confirmation of endotracheal intubation by capnography was more in group A (30.78 ± 8.15 sec) than group M (15.93 ± 11.88 sec) \( (P = 0.001) \) making the overall time taken for intubation with group A (42.53 ± 9.17 sec) more than that with group M (33.45 ± 16.15 sec) \( (P = 0.003) \) [Table 2].

The mean CL score in group A was 1.18 ± 0.99 while in group M it was 1.63 ± 0.74. So, the mean score with ML was significantly more than with AVL \( (P = 0.001) \). The mean POGO in group A was 95.00 ± 11.60 while in group M was 77.50 ± 28.19. So, the mean POGO with ML was significantly less than AVL \( (P = 0.001) \). The mean IDS in group A was

![Figure 1: CONSORT diagram](image-url)
1.00 ± 0.99 while in group M, it was 1.75 ± 1.64. So, the mean IDS was more with ML than with AVL, however the difference was not significant (P = 0.051).

Optimization maneuver was used in 20% and 40% patients in group A and group M, respectively. However, no significant difference was observed in proportion between the two groups (P = 0.051).

On comparing the hemodynamic variability while performing intubation in both the groups in terms of HR, mean BP and saturation we found that HR in both the groups were comparable at 0, 1, 2, 5 and 10 min and no significant difference was seen between the groups [Figure 2]. Regarding the mean BP, the groups had non-significant variations at time interval of 0 and 1 min but patients had comparatively stable mean BP at 2 and 5 min in group A than group M. At 10 min, the values again became comparable in both the groups [Figure 3].

In the group A airway pain was absent in 75.0% patients, mild and moderate pain were present in 22.5% and 2.5% patients, respectively. In the group M, no airway pain was found in 45.0% cases, mild, moderate, and severe pain was present in 20%, 25%, and 10.0% patients, respectively. The difference between the groups was statistically significant (P = 0.002) [Figure 4].

**Discussion**

In the present study, it was observed that the duration of visualization of glottis during laryngoscopy was less with Airtraq video laryngoscope than with Macintosh laryngoscope but the time to intubate the trachea following visualization was more with Airtraq making the overall time taken for intubation more with it than Macintosh laryngoscope. Similar results were reported by Vlatten et al.\(^5\) for pediatric patients and Chalkeidis et al.\(^6\) in a study for adult patients. Maharaj et al.\(^3\) concluded that the AVL may be slightly easier to use, but there was no difference between the AVL and ML in terms of the time needed for intubation. But his study was done for routine airway management and not in any specific type of patients. On the contrary, various studies have shown that AVL reduces intubation time for experienced as well as novice intubators.\(^7\)\(^8\)\(^9\)\(^10\) Decamps et al.\(^11\) also reported high pass success rates with channelled VLs but the study was done in simulation mannikins in contrary to patients.

The inference is that the difference observed in the present study regarding the time required for the intubation was probably due to the use of armored endotracheal tube in our patients. Till now no study has been done using flexometallic tubes with AVL. Due to the exaggerated curvature of the distal blade, flexometallic tubes could not proceed along the line required for endotracheal intubation. We tried to overcome this drawback by using a preloaded bougie, but not much difference was seen and the procedure still took more time. Second possible reason is that due to a dedicated channel in Airtraq for the ET tube which allows only forward and backward movement of the tube and any manipulation in the tube like any angulation or change in direction was not permitted. The only thing which could be done was modification of the position of laryngoscope. So, the three-dimensional movement of ET tube was not possible with AVL. Thirdly, all the anesthesiologists included in the study were more trained with the use of ML and the learning curve of AVL was much small for all of them.

The results of POGO, CL score, and IDS score of this study showed that the glottic view was very much better in AVL than with ML and are consistent with the results of Maharaj et al.\(^3\)

### Table 1: Comparison of demographic profile in the two groups

| Variable          | Group A (n (%) | Group M (n (%)) | t/chi sq-value | P |
|-------------------|---------------|----------------|----------------|---|
| Age (in years) (Mean±SD) | 36.83±11.24   | 36.88±12.47 | 0.02 | 0.985 |
| Weight (in kg) (Mean±SD)    | 57.00±9.85    | 56.30±10.08  | 0.31 | 0.754 |
| Gender             |               |               |                |   |
| Female [n (%)]     | 30 (75%)      | 32 (80%)      | 0.287          | 0.592 |
| Male [n (%)]       | 10 (25%)      | 8 (20%)       |                |   |
| ASA Grade          |               |               |                |   |
| Grade – I [n (%)]  | 28 (70%)      | 29 (72.5%)    | 0.061          | 0.805 |
| Grade – II [n (%)] | 12 (30%)      | 11 (27.5%)    |                |   |

SD: Standard deviation, ASA: American Society of Anesthesiologist

### Table 2: Comparison of the time taken for intubation in the two groups

| Variable                                              | Group A (Mean ± SD) | Group M (Mean ± SD) | t  | P   |
|-------------------------------------------------------|---------------------|---------------------|----|-----|
| Total time taken in successful intubation (seconds)   | 42.53 ± 9.17        | 33.45 ± 16.15       | 3.090 | 0.003 |
| Time taken from insertion of laryngoscope to visualization of glottis (seconds) | 11.75 ± 3.34        | 17.64 ± 12.54       | 2.869 | 0.005 |
| Time taken from visualization of glottis to confirmation of endotracheal intubation (seconds) | 30.78 ± 8.15        | 15.93 ± 11.88       | 6.518 | <.001 |
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who also concluded similarly when compared both apparatus in routine airway management. Laryngoscopy with AVL does not require displacement of the tongue and forceful elevation of the epiglottis and thus less force is required for glottis visualization and intubation as compared with the conventional direct laryngoscopy, and thus the difficult airway parameters are better with it.

Optimization maneuvers used in the study were noted in terms of medialization of trachea by applying BURP, application of shoulder roll or any other manipulation to aid intubation. Optimization was required more with ML. The difference was not significant statistically but it was significant clinically. This difference was probably due to the exaggerated curvature of the blade and an internal arrangement of optical components in AVL which provides a view of the glottis without alignment of oral, pharyngeal, and tracheal axes. It is consistent with the results of McElwain et al. who did tracheal intubation in patients with cervical spine immobilization using manual inline axial spine stabilization which showed reduced optimization maneuvers needed with AVL and thus should be preferred in patients with cervical spine trauma.

HR and BP increased in similar manner in response to intubation with both the devices. Varsha et al. reported a better hemodynamic stability with Airtraq VL as compared to Macintosh in patients with ischemic heart disease.

Postoperative airway symptoms like any oral trauma, dental trauma, or hoarseness in voice were more prominent in patients on whom intubation was done with ML, as reported by Ranieri et al. also. This difference can be attributed to the less manipulations required during the intubation with AVL as the shape of laryngoscope blade was more aligned to the oro-pharyngeal axis.

In a recent meta-analysis done to compare AVL and ML for intubation done in general anaesthesia, the authors found a reduced failed intubation and time needed for intubation, but no benefits on the associated adverse events with AVL. The difference in the results of meta-analysis from our study might be due to the difference in patient group taken for the study.

Despite all the effective measures taken, we came across a few limitations in this study. The study was only single blinded as the blinding of the operator using the device was not possible. Secondly, many of the secondary outcomes like CL score and POGO were subjective and dependent on analyzer.

Keeping the whole study into consideration it can be concluded that AVL should be considered as a better option than ML for endotracheal intubation in patients undergoing surgery with thyroid swelling, or requiring intubation in these patients for any non-surgical indications. Better CL score and POGO reduce the risk of esophageal intubation and thus also reduce the chance of failed intubation, and thus, increasing the efficiency of endotracheal intubation done even by less trained medical professionals. This knowledge will enhance the scope of new intubation techniques and apparatus like AVL, which can be helpful in many anticipated and unanticipated scenarios of airway handling. In future, studies with larger sample size and with other difficult airway situations can be helpful in stating the utility of AVL more firmly.

Declarations of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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