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A Comparative Study of Difficult Tracheal Intubation Using Airtraq and Light Wand in Adult Patients

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Abstract

Background: Airway management is critical in anesthesia, with difficult intubation posing significant risks. This study compares the efficacy of Airtraq and Lightwand devices in adult patients with anticipated difficult airways, focusing on intubation success, duration, hemodynamics, and complications.

Objectives: To compare Airtraq and Lightwand in terms of intubation time, success rates, hemodynamic responses, and complications in patients with difficult airways.

Methodology: A prospective, observational study was conducted on 80 ASA I/II patients with Mallampati grades III/IV, randomly assigned to Airtraq (n=40) or Lightwand (n=40) groups. Parameters measured included intubation duration (T1: device insertion to visualization/glow; T2: tube placement), number of attempts, hemodynamic changes (heart rate, blood pressure), and complications (e.g., trauma, sore throat). Statistical analysis was performed using SPSS.

Results: Both groups showed comparable demographic and airway characteristics. Mean intubation times were similar (Airtraq: 32.43±15.76 sec; Lightwand: 31.83±14.29 sec; p=0.630). First-attempt success rates were high (Airtraq: 97.5%; Lightwand: 92.5%; p=0.615). Hemodynamic responses (heart rate, systolic/diastolic pressure) were comparable at all stages (p>0.05). Complications were minimal (Airtraq: 2.5% lip trauma; Lightwand: 5% gum trauma; p=0.261). No significant differences were observed in optimization maneuvers or failure rates.

Conclusion: Airtraq and Lightwand are equally effective for tracheal intubation in difficult airways, with no significant differences in time, success rates, hemodynamics, or complications.

Keywords: Airtraq, Lightwand, difficult intubation, airway management, hemodynamic response.

Introduction

The primary responsibility of the anesthesiologists as a clinician is to safeguard the airway i.e. to preserve and protect it during induction, maintenance and recovery from the state of anesthesia and in the event of loss of the airway, it should be promptly re- established before the individuals suffers irreversible injury from inadequate or compromised oxygenation[1]. More than 85% of all respiratory related closed malpractice claims involve a brain damaged or dead patient and inability to successfully manage very difficult airways has been responsible for as many as 30% of deaths totally attributable to anesthesia[2].

Airway is very important from anesthesia point of view. Various methods have been used to secure an airway e.g. Orotracheal, nasotracheal and tracheostomy of which an orotracheal intubation is one which is most commonly used[3]. There are various methods available for orotracheal intubation. Difficult intubation remains one of the major risks in anesthesia practice[4]. Parameters like inter-incisor gap (mouth opening), temporomandibular joint function i.e. Subluxation, Mallampati classification, thyromental distance, mentosternal distance, assessment of atlanto-occipital joint extension and neck flexion, mandibular space (includes thyromental distance and the horizontal length of mandible), receding mandible; buck teeth, neck swelling is helpful in anticipating difficult intubation[5,6]. In a difficult airway situation, all conditions should be optimized.

The Airtraq is a relatively new tracheal intubation device that has been developed for the management of normal and difficult airways. The blade of the Airtraq consists of two side-by-side channels[7]. It is designed to provide a view of the glottis without using the classic sniffing position, which is needed to align the oral, laryngeal, and tracheal axis. Recently the Airtraq has been reported to limit cervical spine movement, without an increase in the intubation time[8].

The Lightwand is a simple technique which helps in less manipulation of cervical spine movement during tracheal intubation without an increase in intubation time[9]. This a stylet with a light bulb at the end, that glows bright through the soft tissues of the anterior neck when it is placed inside the glottis. After the confirmation of transillumination, the threaded tracheal tube can be passed blindly into the trachea the lightwand involves a blind technique. Our study is about to compare the ease of intubation using Airtraq and Lightwand device in terms of duration of intubation, number of attempts, changes in hemodynamics and complications.

Material and Methods

Our study was a prospective, observational study was conducted at Rajarshee Chhathrapati Shahu Maharaj Government Medical College and Chhatrapati Pramila Raje Hospital, Kolhapur. The study consisting of 80 patients 18 To 65 years, posted for surgical procedures under general anesthesia, belonging to ASA grade I and II, with MPC Grade III (3) and IV (4) and thyromental distance < 6 cms or Inter-incisor distance < 4 cms. Patients at risk of pulmonary aspiration of gastric contents, patients with pathology in neck, upper

respiratory tract or upper airway trauma in case of Lightwand as it is a blind technique, were excluded from the study. The Ethics Committee approval was obtained to conduct the study.

Patients were randomly assigned to each group of intubation device by tossing as the Airtraq (AL) and the Lightwand (LW) group (40 patients each). Airway assessment was done clinically by Mallampati classification[7] (MPC) for oropharyngeal view. Along with routine general and systemic examination, thorough airway assessment was carried out. It included MPC- grading, Thyromental distance, Mentosternal distance, interincisor gap. Patient received sedation Inj. Midazolam 0.03 mg/ kg IV, Inj.Fentanyl 2 ug/kg IV. After preoxygenation, patients were induced with Inj. Propofol 2 mg/kg IV. Mask ventilation confirmed and inj. Vecuronium 0.08 mg/kg IV is given.

The patient's neck was kept in neutral position during intubation and tracheal intubation was performed using either Airtraq or Lightwand. The following parameters were measured: number of attempts, duration of intubation, hemodynamic response like heart rate, systolic and diastolic blood pressure were recorded at baseline, at device insertion, at intubation, and 10 min after intubation.

Complications like trauma to lips, gum trauma, tooth fall, tooth loosening, secretion, laryngospasm, bronchspasm, desaturation, sore throat were noted and recorded.

Duration of insertion of Airtraq till visualization of cord (T1)- The time taken from removal of face mask and insertion of Airtraq device between the teeth to visualization of vocal cords.

Duration of intubation attempts using Airtraq (T2) - The time taken from visualization of vocal cords and passing the endotracheal tube in the trachea and confirmation of its tracheal placement by appearance of mist in the endotracheal tube, chest wall movements, etc. Total duration of intubation: T=T1+T2(sec).

Duration of insertion of Lightwand till glow of the bulb is seen above thyroid prominence (T1) - The time taken from removal of face mask and insertion of Lightwand device from the base of the tongue till the glow of the bulb was seen on either side of thyroid prominence which was then withdrawn approximately till submentum and rotated towards midline till glow was seen just above thyroid prominence.

Duration of intubation attempts using Lightwand (T2) - The time taken from visualization of the glow of the bulb seen in midline just above thyroid prominence and passing the endotracheal tube in the trachea and confirmation by passing the glow in trachea till suprasternal notch also by appearance of mist in the endotracheal tube, chest wall movements, etc. Total duration of intubation: T=T1+T2(sec).

Data was entered into Microsoft excel data sheet and was analyzed using SPSS 26 version software. P value (probability that the result is true) of 0.05 was considered as statistically significant after assuming all the rules of statistical tests

Observation and Results

Table 1: Demography Characteristics AGE (in yrs), GENDER /ASA grade (%)

Parameters		Airtraq	Lightwand	P value
Mean Age (yrs)		40.58±10.70	41.73±10.93	0.636(NS)
Gender	Male	24(60%)	22(55%)	0.821(NS)
	Female	16(40%)	18(45%)	
ASA Grade %	I	30(75%)	28(70%)	0.803(NS)
	II	10(25%)	12(30%)	
TMD Distance(cm)		5.85±0.06	5.83±0.08	0.265(NS)
SMD Distance(cm)		14.07±0.45	14.24±0.62	0.159(NS)
IIG Distance(cm)		3.84±0.07	3.81±0.10	0.118(NS)
MPC grades	III (3)	39 (97.5%)	38(95%)	0.556(NS)
	IV (4)	1 (2.5%)	2(5%)	
Total		40(100%)	40(100%)	

ASA: American society of Anaesthesiology, TMD: Thyromental distance.; SMD: sternomental distance.; IIG: Interincisor distance.

In Airtraq group, mean age was 40.58 ±10.70 yrs and in Lightwand group it was 41.73 ±10.93yrs. In Airtraq group, M/F was 24/16 and in Lightward group it was 22/18. P value is 0.821. In Airtraq group 75% (30) were in ASA I GROUP and 25% (10) in ASA II group. In Lightwand 70% (28) were ASA I group and 30% (12) in ASA II group. All the p values are >0.05 and groups are comparable.

In AL Group TMD is 5.85 ± 0.06 cm, SMD Is 14.07 ± 0.45cm, and IIG is 3.84 ± 0.07cm. In LW Group TMD is 5.83 ± 0.08 cm, SMD Is 14.24± 0.62cm, and IIG is 3.81±0.10cm. In AL group 97.5% (39) patients belongs to MPC III and 2.5% (1) to MPC IV while. In LW group 95% (38) patients belongs to MPC III and 5% (2) to MPC IV. Bboth p values are >0.05 and its not statistically significant. Both groups are comparable.

Table 2: Comparison Between the Groups for T1 time (sec):

Parameters	Airtraq	Lightwand	P value
Mean T1 Time (secs)	19.50 ±12.96	17.90 ±11.82	0.566(NS)
Mean T2 Time (secs)	12.93±4.73	13.93±6.22	0.420(NS)
Mean Total duration	32.43±15.76	31.83±14.29	0.630 (NS)

Mean T1 Time of Airtraq and Lightwand were 19.50 ±12.96 secs and 17.90 ±11.82 secs respectively and difference was not significant (p value 0.566). Mean T2 Time of Airtraq and Lightwand were 12.93±4.73 secs and 13.93±6.22 secs respectively and difference was not significant (p value 0.420). The mean duration of intubation was 32.43±15.76 in Airtraq group and 31.83±14.29 in Lightwand group and difference was not significant.

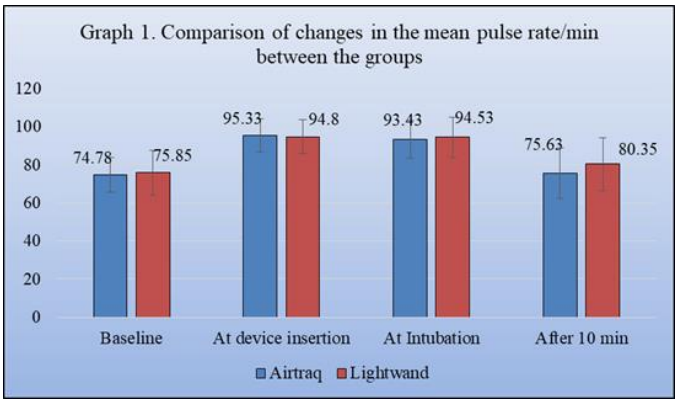
Table 3: Comparison of Number of attempts required for intubation between the groups.

Parameters		Airtraq	Lightwand	P value
No. of Attempts	1	39 (97.5%)	37 (92.5%)	0.615
	2	1 (2.5%)	3 (7.5%)	
Optimizing Maneuver	Yes	1 (2.5%)	2 (5%)	1.00
	No	39 (97.5%)	38 (95%)	
Total		40(100%)	40(100%)	

In Airtraq group 97.5% (39) patients were intubated in 1st attempt whereas only 2.5% (1) required 2nd attempt. In Lightwand group 92.5% (37) patients were intubated in 1st attempt whereas only 7.5% (3) required 2nd attempt, p value is 0.615 (not statistically significant) and both groups are comparable. In airtraq group 2.5% patients required optimizing manoeuvre while In Lightwand group, 5% patients required optimizing manoeuvre, p value is 1.00 (not statistically significant) and both groups are comparable.

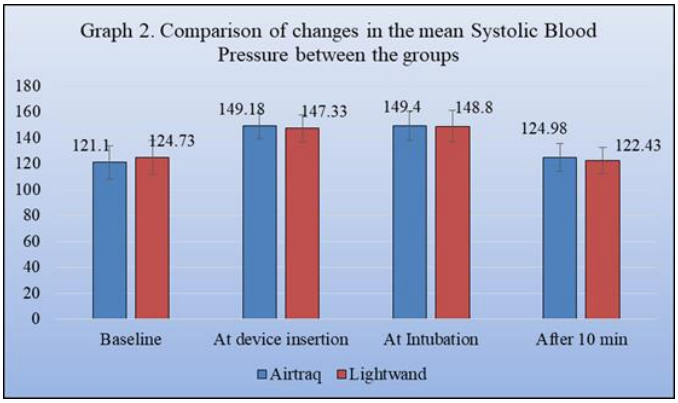
Comparison of changes in the mean pulse rate/min between the groups:

In Airtraq group baseline HR was 74.78± 9.11, at device insertion it was 95.33 ± 8.71 At intubation it was 93.43 ± 9.92 and after 10 min it was 75.63±13.27 In Lightwand group baseline HR was 75.85±11.83, at device insertion it was 94.80±9.04 At intubation it was 94.53±10.50 and after 10 min it was 80.35±13.71. All P values are >0.05 and it's not statistically significant. Both groups are comparable.

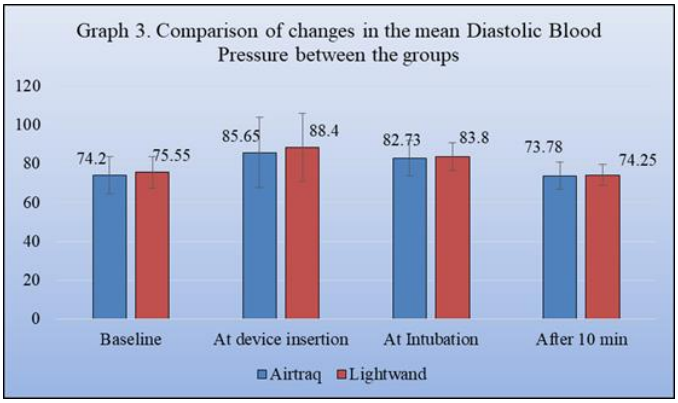


Comparison of changes in Mean Systolic Blood pressure (mmHg) between the group:

In Airtraq group baseline SBP was 121.10±12.95 at device insertion it was149.18±9.71, At intubation it was 149.40±11.19 and after 10 min it was 124.98±10.82. In Lightwand group baseline 124.73±13.23 SBP was at device insertion it was 147.33±10.43, At intubation it was 148.80±12.26 and after 10 min it was 122.43±9.99. All p values are >0.05 and it's not statistically significant. Both groups are comparable.



Comparison of changes in the mean diastolic blood pressure (mm Hg) between the groups:



In Airtraq group baseline DBP was 74.20±9.60 at device insertion, it was 85.65±18.08. At intubation it was 82.73±9.08 and after 10 min it was 73.78±6.88. In Lightwand group baseline DBP was 75.55±8.25 at device insertion it was 88.40±17.42. At intubation it was 83.80±7.18 and after 10 min it was 74.25±5.36. All p values are >0.05 and it's not statistically significant. Both groups are comparable.

Table 4: Comparison of Complications between the groups:

Complications	Airtraq	Lightwand	p value
Sore Throat	1 (2.5%)	1 (2.5%)	0.261
Gum Trauma	0 (0%)	2 (5%)	
Lip Trauma	2 (5%)	0 (0%)	
Nil	37 (92.5%)	37 (92.5%)	

Airtraq group had only 1 patient with sore throat, 2 patients with lip trauma. No patients with gum trauma. Lightwand group had only 1patient with sore throat, 2 patients with gum trauma, No patients with lip trauma. p value is 0.261 P value is >0.05 and it's not statistically significant. Both groups are comparable.

Discussion

Our study is aimed to compare the ease of intubation using Airtraq and Lightwand device in terms of duration of intubation, number of attempts, changes in hemodynamic and complications. Among two groups we have compared the following.

Gender distribution of patients

In This study, M/F ratio was 24/16 and 22/18 respectively. Both groups are comparable. S. Kihara, Brimacombe J et al (2003)[10] studied 75 normotensive (ASA physical status I) and 75 controlled hypertensives (ASA physical status II) patients. Male to female ratio was 58/42% in normotensive group and 47/53% in hypertensive group. p value was > 0.05 which is not statistically significant. Ka-young Rhee, Lee JR et al (2009) [11] performed a study comparing a lighted stylet (Surch-Lite™) (SL) with direct laryngoscopy in patients with high Mallampati scores. Gender wise distribution for (male/female) was (16/14) in direct laryngoscopy group and (18/12) in lightwand group. p value was > 0.05 which is not statistically significant.

Age (in years): In our study, the mean age was 40.58± 10.70 yrs in Group AL and 41.73±10.93 yrs in group LW. Age in both groups was comparable. S. Kihara, Brimacombe J et al (2003)[10]. Mean age in direct laryngoscopy group was 61.5±11.5 years, 61.5±7 years in Lightwand group and 61.5±11.5 years in ILMA group. P value was > 0.05 which is not statistically significant. Ka-young Rhee, Lee JR et al (2009) [11] Mean age in direct laryngoscopy group was 52±12 years and 49±11 years in Lightwand group (p value NS)

American Society of Anaesthesiology (ASA) Grade (%):

In our study 75% patients were belonging to ASA I, 25% were belonging to ASA II in AL group, 70% patients were belonging to ASA I, 30% were belonging to ASA II in LW. Both groups are comparable. Dhonneur G, Ndoko SK et al (2007) [12] studied 80 patients of ASA I/II/III. p value was > 0.05 which is not statistically significant. Marwa A, Tolon et al (2012) [(13)] studied 40 patients. In AL group ASA I/II was 5/15 And in ML group it was 7/13. P =0.375. P value was > 0.05 which is not statistically significant. E. Y. Park, Kim JY et al (2010) [(9)] studied 100 patients of ASA I/II.

Airway Assessment

Thyro-mental Distance (cms):

In our study the mean TMD (cm) in AL Group was 5.85± 0.06 cm, and in LW Group it was 5.83± 0.08cm. P value is 0.265. These values are comparable between both groups. C H Maharaj, Buckley et al (2007) [14] Mean thyromental distance for ML group was 6.5±0.6 cm while for the AL group it was 6.4±0. 4cm. p value was > 0.05 which is not statistically significant. E. Y. Park et al (2010) [9]. Mean thyromental distance for AL group was 7.2(0.6) cm while for the LW group it was 6.7cm (0.6).

Inter Incisor Gap (cms)

In our study, the mean inter incisor Gap for AL group was 3.84±0.07cm; cm while for the LW group it was 3.81±0.10 cm. p value >0.5 and difference was not significant. CH Maharaj D. et al (2006) [15] Mean interincisor distance for ML group was 4.5(0.8) cm while for the AL group it was 4.3(0.7) cm, p value was > 0.05 which is not statistically significant. Dhonneur G et al (2007) [12] Mean interincisor distance in lean patient was 4.3(0.3) cm with Standard technique and 4.1(0.2) cms in reverse manoeuvre. While in obese patient was 3.7(0.2) cms with standard technique and 3.9(0.3) in reverse manoeuvre. P value was > 0.05 which is not statistically significant.

Sterno-mental Distance (cms)

In our study the mean sternomental distance in Group AL was 14.07± 0.45cm, in Group LW was 14.24± 0.62 cm. p value >0.5 and difference was not significant. S. Kihara et al (2003)[10] studied 100 patients. Mean sternomental distance for normotensive direct laryngoscopy group was 17±2cm while for the normotensive Lightwand group it was 16±3 cm & in normotensive ILMA group it was17±2 cm, hypertensive direct laryngoscopy group was 17±3 cm while for the hypertensive Lightwand group it was17±2 cm & in hypertensive ILMA group it was 16±2 cm. p value was > 0.05 which is not statistically significant.

Mallampati Classification

In our study, in AL group 97.5% (39) patients belongs to MPC III and 2.5% (1) to MPC IV while in LW group 95% (38) patients belongs to MPC III and 5 % (2) to MPC IV. p value >0.5 and difference was not significant. S. Kihara et al (2003) [(10)]. In direct laryngoscopy group, 18 patients (36%) had MPC II, 31 patients (62%) had MPC I, and 1 patient (2%) had MPC III, while in lightwand group, 12 patients (24%) had MPC II, 37 patients (74%) had MPC I, and 1 patient (2%) had MPC III. In ILMA group, 13 patients (26%) had MPC II, 36 patients (72%) had MPC I, and 1 patient (2%) had MPC III. p value was > 0.05 which is not statistically significant. Dhonneur G et al (2007) [(12)] In lean patient 14 patients were having MPC I and 6 were having MPC II with Standard technique and 13 patients were having MPC I ,6 was having MPC II and 1 was having MPC III in reverse manoeuvre. while in obese patient 5 patients were having MPC I, 9 were MPC II, and 6 were MPC III Standard technique whereas 5 patients were having MPC I , 8 were MPC II, 6 were MPC III and 1 patient was MPC IV in reverse manoeuvre. P value was > 0.05 which is not statistically significant.

Number of Attempts of Intubation

In our study we found that number of attempts (1/2/3 or more) in AL (39/1/0) and (137/3/0) in LW group. P value is 0.615. Both groups are comparable to each other and p value was > 0.05 which is not statistically significant. Though the number of attempts required in

our study was more than E PARK study the p value was not statistically significant.

When we compared our study with above studies having Macintosh group we found that Airtraq and Lightwand required less attempt as compared to Macintosh. But here also p value was > 0.05which is not statistically significant. Marwa A et al (2012)[13] number of intubating attempts although was less in AL group yet there was no significant difference between two groups. p value was > 0.05 which is not statistically significant. E. Y. Park et al (2010) [(9)] found that number of attempts (1/2/3 or more) in AL 50/0/0 and 50/0/0 in LW group. None of the patient required 2nd attempt. P value was > 0.05 which is not statistically significant. We didn't come across failed intubation using either device and so we didn't apply cross over technique during our study.

Duration of Intubation

We found that in studies including Macintosh group in Patients with cervical spine immobilization there was a significant increase in intubation duration as compared to Airtraq. This can be explained by the fewer manoeuvres required in the AL group to improve the glottis exposure compared to the ML group where there was more difficulty to obtain a view of the glottis while performing manual in-line axial stabilization (MIAS). Thus, in Patients with cervical spine immobilization, Airtraq is superior to get glottic view and reduce intubation time. Marwa A, Tolon et al (2012)[13]. Duration of the intubation procedure was significantly longer in ML group than AL group (34.3± 12.27 s in AL group versus 48.75 ± 21.57 s in ML group), P value was significant p<0.05. duration of intubation attempts was significantly shorter with the AL group when compared to the ML group. Matheus Felipe de OS et al (2010) [16] did a comparative study between the laryngoscope and lighted stylet in tracheal intubation in 98 patients. The mean time of intubation was 22 ± 16 seconds in Group Lightwand, and 18 ± 7 seconds in Group laryngoscopy (p = 0.11), which was not statistically significant. p>0.05

Number of Optimisation Manoeuvre (%)

In our study, 1 (2.5%) patient required optimizing manoeuvre like (hyper extension of neck) in Airtraq group. IN Lightwand group 2 (5%) patients required similar optimizing manoeuvre. p value is 1.0**.** p value is >0.05 and its not statistically significant. Both groups are comparable. C H Maharaj et al (2007) [(14)] found that number of optimization manoeuvre (0/1/=2) in ML group was 12(60) /5(25)/ 3(15) respectively and in AL group it was 20(100) /0 /0. Marwa A et al (2012) [(13)] ML group had statistically significant more optimization maneuvers than AL group (0.10±0.031) in AL group versus (0.85± 0.081) in ML group. P value was < 0.05 which is statistically significant.

Several simple manoeuvres are helpful during intubation. These include a jaw lift; use of the thumb of the non-dominant hand to lift the tongue; hyperextension of the head and neck; and having an assistant to pull the tongue forward.

Magnitude of Pressure Response

Mean Pulse Rate

At all the time line, mean Pulse Rate was comparable in both groups. Matheus Felipe de SO et al (2010) [16] did a comparative study between the laryngoscope and lighted stylet in tracheal intubation in 98 patients and found no significant changes in heart rate between the Lightwand technique and direct vision laryngoscopy during and after tracheal intubation. CH. Maharaj, Buckley et al (2007)[14] Tracheal intubation with the Macintosh resulted in a significant increase in heart rate

compared with preintubation values, in contrast to the Airtraq. There were significant differences between-group in heart rate after intubation. p<0.05 which is statistically significant.

In our study we found that there was no difference heart rate between two groups, during device insertion, intubation and after 10 min of intubation. P value is >0.05 and its not statistically significant. Both groups are comparable. Our study was comparable to E Y PARK study. In studies comparing Lightwand and Macintosh there was no significant difference between the groups with respect to heart rate but in studies comparing Airtraq and Macintosh, Macintosh showed more significant increase in heart rate. p<0.05 which is statistically significant.

Mean Preoperative Systolic Blood Pressure

In Airtraq group baseline SBP was 121.10±12.95 and in Lightwand group baseline SBP was 124.73 ±13.23. P value is 0.219. P value is >0.05 and its not statistically significant. Marwa A, Tolon et al (2012)[13] there was statistically significant increase mean arterial blood pressure values at all periods following intubation in group II (ML group) while group I (AL group) showed no statistically significant changes. The reason being the same that the AL provides a view of the glottis without a need to align the oral, pharyngeal and tracheal axes, and therefore requires less force to be applied during laryngoscopy.

E. Y. Park, Kim JY et al (2010) [9] studied 100 patients of ASA I/II. They found no difference between both groups with respect to hemodynamics. They believe that this is because neither device requires the added stimulation of lifting of the mandible. p>0.05 which is not statistically significant.

Comparison of Airtraq with Macintosh studies showed significant increase mean arterial blood pressure mainly in patients with cervical spine immobility being intubated by Macintosh. As the AL provides a view of the glottis without a need to align the oral, pharyngeal and tracheal axes, and therefore requires less force to be applied during laryngoscopy which gives less hemodynamic response.

Complications

In our study it can be seen that Airtraq group had only 1 patient with sore throat, none of them had gum trauma, 2 patients had lip trauma. Lightwand group had only 1 patient with sore throat, 2 patient with gum trauma, none of the patients with lip trauma. All studies showed no or minimal complications with both groups. p value is 0.261. Matheus Felipe de OS et al (2010) [(16)] found hoarseness was the only data that showed statistically significant differences being more predominant in Group E (p = 0.05) i.e Lightwand group as compared to laryngoscopy

Ka-young Rhee et al (2009)[53] observed that patients in Laryngoscopy group had more postoperative pharyngolaryngeal complaints but there was no statistically significant difference between the two groups. Marwa A et al (2012)[13] There were no statistically significant differences between the two groups as regards to the complications (lip or tongue bruising and teeth clicking) although the ML group showed some complications while the AL group did not show any of them.

Conclusion

In this study we compared tracheal intubation by using Airtraq and Lightwand and this study demonstrated that there was no difference in intubation time, success rates and hemodynamic variables and complications between

the Airtraq and Lightwand in patients with anticipated difficult intubation during airway management.

Limitations

The lack of an intubation difficulty score is a limitation. To measure the intubation difficulty score for the lightwand, which is a blind technique, direct laryngoscopy would have been required to observe the structures around the vocal cords before the lightwand was inserted which may have influenced the hemodynamics. Our results can defer from the original study as the devices are new, technique is new and proper placement of device needs optimization manouvre, skills of anesthesiologist may defer and needs expertization and need further evaluation.

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