Original article

Comparison of assessment of vocal cord mobility following thyroid surgery using Macintosh Laryngoscope and Airtraq

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Abstract

Introduction: Vocal cord assessment after thyroidectomy, routinely performed by anaesthesiologist by direct laryngoscopy in the immediate postoperative period is associated with significant haemodynamic changes and patient discomfort. **Aim:** Comparison of patient comfort, haemodynamic response and accuracy of assessment of vocal cord mobility between Airtraq and Macintosh laryngoscope. **Methodology**: In a prospective, randomised controlled study, 82 euthyroid patients, ASA PS 1-2, aged 20-60 years, of either gender undergoing thyroidectomy under general anaesthesia were randomised to one of two groups, Group M and Group A. Anaesthesia was induced with propofol and fentanyl, maintained with morphine, vecuronium, nitrous oxide and isoflurane in oxygen to maintain a MAC of 1-1.3%. At the end of surgery, patients were extubated after complete reversal of neuromuscular blockade and when fully awake. Vocal cord movement and haemodynamic changes were assessed three minutes later using either Airtraq (Group A) or Macintosh laryngoscope (Group M). Patient reactivity score (Favourable - No grimace or facial grimace; Unfavourable – Any head, neck and limb movements or cough). Vocal cord movements were again assessed by an ENT surgeon 48 hours later. **Results:** Demographic data, type and duration of surgery were similar in both groups. 63.4% of patients in Group A had favourable scores compared to 29.3% in Group M even though duration of laryngoscopy was longer in Group A. There was no significant difference in haemodynamic changes between the groups. **Conclusion:** Patients are more comfortable during vocal cord assessment with Airtraq laryngoscopy even though duration of laryngoscopy is longer when compared to Macintosh laryngoscope.

Keywords: Airtraq, macintosh laryngoscope, thyroidectomy, vocal cord assessment

Introduction

Thyroid surgery can be associated with dysfunction of vocal cords postoperatively, either due to injury to the recurrent laryngeal nerve or oedema of the nerve. It can be unilateral or bilateral, partial or complete. Such dysfunction can result in considerable morbidity and rarely mortality. Consequently, most surgeons request the anaesthesiologist to perform a laryngoscopy after completion of surgery to record vocal cord movements.

The anaesthesiologist assesses the larynx usually with a Macintosh laryngoscope and continues to do it so that the surgeon himself can also have a look to confirm the vocal cord mobility. This procedure is usually performed when the patient is recovering from the effects of muscle relaxants and anaesthetics, and after return of reflexes. This can be associated with hypertension, tachycardia and arrhythmias apart from considerable discomfort to the patient. To avoid this, extubation under deep anaesthesia

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may be done but this can occasionally be associated with laryngospasm and its disastrous consequences.

The use of Airtraq instead of a direct laryngoscope is possibly associated with less haemodynamic responses and discomfort to the patient. In addition, the laryngoscopic view is visible to the surgeon directly and simultaneously as the anaesthesiologist thus shortening the laryngoscopy time.

The aim of this study was to compare patient comfort, haemodynamic responses during assessment and accuracy of assessment of vocal cord mobility after thyroid surgery using Macintosh and Airtraq laryngoscopes.

Methodology

A total of 82 patients were included in this prospective, randomised, controlled study. The study commenced after obtaining the approval of the departmental dissertation committee and the institutional ethics committee. A written informed consent was obtained from all patients.

Patients aged between 20-60 years, either gender, belonging to ASA PS I and II, with a BMI 17.5 – 30 kg/m^2, who were euthyroid as evidenced by normal serum T_3 and T_4 and posted for elective thyroid surgery were included.

Patients with anticipated difficult airway, those at risk of regurgitation and pulmonary aspiration (history of reflux, pregnancy), BMI > 35 kg/m^2 and those with pre-existing vocal cord palsy as seen in preoperative videostroboscopy (performed by the ENT surgeon in the outpatient department) were excluded.

There were *five* observers in the study

Observer 1: The anaesthesiology postgraduate student doing the study who examined the patient preoperatively. He also obtained informed consent from the patient as well as explained the use of visual analogue scale for assessment of discomfort due to the vocal cord assessment after surgery.

Observer 2: Consultant anaesthesiologist who randomised patients into one of two groups (Group M or Group A), did the vocal cord assessment with Airtraq or Macintosh laryngoscope, depending on the group.

Observer 3: The postgraduate anaesthesiologist in-charge of the case who recorded the patient reactivity score to assess patient discomfort.

Observer 4: The operating surgeon who also assessed vocal cord movement by either of the methods.

Observer 5: The ENT surgeon who assessed the vocal cord movement by indirect laryngoscopy 72 hours postoperatively.

Preoperative evaluation was done by Observer 1, one day prior to surgery. All patients were fasted according to standard guidelines. Premedication was given as per discretion of concerned consultant anaesthesiologist. If the patient had any evidence of acid peptic disease or gastro-oesophageal reflux disease, they were also given Tab Metoclopramide 10 mg and Tab Ranitidine 150 mg night before and on morning of surgery.

On the day of the surgery, after confirmation of patient identity and fasting status, the patient was shifted to the operation theatre. Monitoring included 5 electrode electrocardiogram, noninvasive blood pressure and pulse oximetry. Baseline values were recorded and intravenous access secured.

The patient was then preoxygenated for 3 minutes. Induction of anaesthesia was achieved with IV fentanyl 2 μg/kg followed by propofol 2-3 mg/kg taking loss of verbal contact as the endpoint of anaesthetic induction. The ability to bag and mask ventilate was confirmed after which vecuronium 0.1 mg/kg was given intravenously to achieve neuromuscular blockade. Ventilation was assisted with 2% isoflurane in 100% oxygen for another 3 minutes. The patient was placed in sniffing position and laryngoscopy performed. Baseline Cormack and Lehane grade of glottic visualisation was noted in all patients during the direct laryngoscopy (1 = Glottic opening fully visible, 2 = Glottic opening partially visible, 3 = Only epiglottis is visible, 4 = No part of larynx is visible). Endotracheal intubation was then done under vision and air entry was confirmed on both the sides. The anaesthetic breathing system was connected to the ventilator.

Anaesthesia was maintained with oxygen, nitrous oxide and isoflurane. The patient was then positioned for thyroid surgery (20 – 30° head up, pillow under the shoulder, head and neck extended). Air entry was confirmed again following positioning. Maintenance dose of neuromuscular blocker was administered as and when required. Morphine 0.1 mg/kg was administered intravenously for analgesia. Paracetamol 1 g IV was given approximately an hour prior to completion of surgery for further analgesia.

At the end of the surgery, an oropharyngeal airway was inserted just prior to discontinuation of inhalational agents. Oropharyngeal suction was done through the airway. Reversal of the neuromuscular blockade was done using neostigmine 0.05mg/kg and glycopyrrolate 0.01 mg/kg IV and normal pattern of breathing was awaited. Inhalational anaesthetic agents were discontinued and the patient administered 100% oxygen.

When the patient became conscious, was able to breathe regularly, was able to cough and showed evidence of purposeful movement, extubation was done and the oral airway was removed. The monitor was set to record blood pressure and heart rate at one minute intervals thereafter. Intravenous lignocaine (1 mg/kg) was administered 90 s prior to vocal cord assessment to reduce the stress response of post-extubation laryngoscopy for assessment of vocal cord function.

The patients were randomly assigned to one of two groups: Group M and Group A.

Group M: A direct laryngoscopy was done 3 minutes after extubation using Macintosh laryngoscope. The view was also shown to the operating surgeon who was requested to position himself to the right of the laryngoscopist. Cormack and Lehane grade of glottic visualisation was noted.

Group A: The Airtraq was introduced into the pharynx 3 minutes after extubation and any visible secretions were removed. The vocal cord assessment was done simultaneously by the operating surgeon and anaesthesiologist. Airtraq was removed soon after the assessment.

Vocal cord movement was graded as follows:

Grade I **-** Both vocal cords had normal movement

Grade II **–** One or both vocal cords had decreased movement

Grade III **–** One or both vocal cords had no movement.

Observations

- Patient discomfort to direct laryngoscopy and the Airtraq was rated on a 5 point reactivity score, as follows
  - 1 - No grimace
  - 2 - Grimacing facial expression
  - 3 - Discomforting head movements
  - 4 - Protective head and limb movements
  - 5 - Coughing or retching
- Blood pressure (systolic, diastolic and mean), SpO_2 and heart rate were recorded one minute prior to direct laryngoscopy or Airtraq placement and every minute for five minutes after assessment of vocal cords in both groups.
- The number of laryngoscopy attempts required to successfully assess the vocal cords were recorded.
- The duration of laryngoscopy was recorded in seconds. Duration of a single laryngoscopy attempt was recorded as the time in seconds from the time the anaesthesiologist inserted the laryngoscope into the mouth to the visualisation of vocal cords.
- Cormack and Lehane grading of laryngoscopic view in group M and POGO scoring of glottic visualisation in group A was also recorded.
- The patient was questioned, two hours after the surgery and on the following morning about any recall of the extubation period and was requested to rate the discomfort on a scale of 0-10, with 0 indicating no discomfort and 10 indicating worst discomfort.
- The patient was examined for vocal cord movement by an ENT surgeon 72 hours postoperatively using indirect laryngoscopy.

- Any complications such as stridor, laryngospasm, desaturation, reintubation, postoperative ventilation, tracheostomy after surgery was also noted.

Based on the results of our pilot study, a difference of more than 30% between the two groups with respect to patient reactivity score was considered significant. For 80% power at 95% confidence limits, a minimum of 41 patients were required to be studied in each group. A total of 82 patients were included in our study. The quantitative data were analysed using Independent sample t test or Mann Whitney U test whereas qualitative data were compared using Fisher's exact test or the Chi Square test.

Results

The demographic data of patients in both groups were comparable (*Table 1*).

Table 1: Demographic data

Parameter	Group A	Group M	P Value
Age (years) (Mean ± SD)	41.77 ± 11.8	43.90 ± 14	0.79*
Gender F / M (n)	36 / 6	33 / 8	0.2**
Weight (kg) (Mean ± SD)	57.8 ± 10.7	57.4 ± 12.7	0.87*
Height (cm) (Mean ± SD)	153.02 ± 8.50	154.44 ± 10.83	0.84*
BMI (kg/m^2) (Mean ± SD)	24.30 ± 3.91	23.83 ± 3.29	0.55*

*Independent Samples T-test, SD - Standard Deviation **Chi Square test

Patients who were ASA PS I or II were enrolled in the study. The comorbidities that the patients had were not significantly different between the groups (*Table 2*).

Table 1: Patient's physical status

	Group A	Group M	P Value*
ASA PS I / II (n)	32 / 9	26 / 15	0.225
Diabetes (n)	4	6	0.737
Hypertension (n)	3	5	0.712
Asthma (n)	2	2	0.675
Others (n)	0	2	-

* Fisher's exact test ** Others –Rheumatoid arthritis (1), Gout (1)

There was no statistical difference in the nature of thyroid swelling between the two groups (*Table 3*).

Table 3: Patient disease status

Diagnosis	Group A	Group M	P Value*
Multinodular goitre	14	14	1
Colloid goitre	11	12	1
Solitary nodule thyroid	7	5	0.756
Papillary carcinoma	4	4	1

*Fisher's exact test

The type of treatment offered to the patient did not have clinical or statistical significance as shown in *Table 4*.

Table 4: Surgical procedure

Surgery	Group A	Group M	P Value*
Total thyroidectomy	20	22	0.825
Hemithyroidectomy	21	16	0.375
Thyroidectomy with modified radical neck dissection	0	3	0.241

*Fisher's Exact test

The duration of surgery was comparable in both the groups with a median duration of 180 minutes (Mann Whitney U test, p – 0.749).

The patient comfort to direct laryngoscopy and the Airtraq was rated on a 5 point reactivity score as described above.

- A score of 1 or 2 was considered *favourable* and a score between 3 and 5 was considered *unfavourable.*
- *Table 5* shows that 63.4% of patients who were assessed using Airtraq belonged to the favourable group while only 29.3% of the patients who were assessed using Macintosh laryngoscope were comfortable. The patients were more comfortable with Airtraq when compared to Macintosh laryngoscope.
- The P value was statistically significant.

Table 5: Surgical procedure

		Patient reactivity score		P Value*
		Favorable (1-2)	Unfavorable (3-5)	
Group A	n (%)	26 (63.4%)	15 (36.6%)	0.002
Group M	n (%)	12 (29.3%)	29 (70.7%)	

*Chi Square test

The number of laryngoscopy attempts required to successfully assess the vocal cords were comparable in both the groups *(Table 6)*.

Table 6: Number of laryngoscopy attempts

No. of attempts	Group A (n)	Group M (n)	P Value*
1	30	35	0.35
2	10	5	
3	1	1	

*Chi square test

The duration of laryngoscopy (time in seconds from the time anaesthesiologist inserts the laryngoscope into the mouth to visualisation of vocal cords) was longer with Airtraq when compared to Macintosh laryngoscope *(Figure 1)*. The P value was statistically significant (Mann Whitney U test $P < 0.001$).

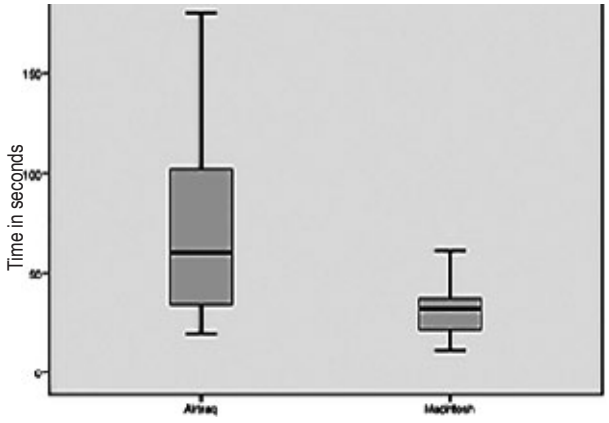

Figure 1: Duration of laryngoscopy

There was no statistically and clinically significant difference between the two groups with respect to laryngoscopic view at extubation as compared to intubation *(Tables 7.1 and 7.2)*. The glottis could not be visualised in 4 patients in group A and 2 patients in group B postoperatively. Of the 4 patients in group A, 2 patients did not allow assessment while 2 patients had poor visualisation due to secretions. Of the 2 patients in group M, 1 patient did not allow laryngoscopy while 1 patient had the best view which was grade 3, and hence cords were not visualised.

Table 7.1: Laryngoscopic view (Cormack and Lehane Grading) at extubation as compared to intubation

			Extubation: CL grade					
			I	II	III	IV	DNA	Second
Group A n (%)	Intubation: CL grade	I	6 (28.6%)	11 (52.4%)	-	-	2 (9.5%)	2 (9.5%)
		II	5 (26.3%)	14 (73.7%)	-	-	-	-
		III	0	1 (100.0%)	-	-	-	-
Group M n (%)		I	6 (31.6%)	12 (63.2%)	-	-	1 (5.3%)	-
		II	2 (10.5%)	16 (84.2%)	1 (5.3%)	-	-	-
		III	1 (33.3%)	2 (66.7%)	-	-	-	-

DNA – Did not assess Second – Second laryngoscopy

Table 7.2: Laryngoscopic view (Cormack and Lehane Grading) at extubation as compared to intubation

	Improved	Remained same	Worsened/ Not visualised	P Value*
Group A	6 (14%)	20 (48.8%)	15 (36.6%)	0.359
Group M	5 (12.2%)	22 (53.7%)	14 (34.1%)	

Observer 2 and 4 were in agreement with respect to the assessment and grading of vocal cord mobility in all the cases. Vocal cords could be assessed successfully in 36 patients in each group *i.e.*, a total of 72 among 82 patients (88% successful assessment).

The accuracy of the vocal cord assessment was compared to that of the ENT surgeon 72 hours postoperatively using indirect laryngoscopy. Vocal cord assessment was accurate 34 times in group A and 29 times in group M *i.e.*, a combined total of 63 among 72 patients assessed (87.5% accurate assessment). There was a 12.5% change in assessment conducted 3 days postoperatively. The difference between the accuracy in vocal cord assessment in the two groups was not clinically significant *(Table 8)*

Table 8: Accuracy in assessment of vocal cord mobility

			Vocal cord movement (Observer 5)		P Value*
			I	II	
Group A	Vocal cord movement (Observer 2 & 4)	I	29	0	> 0.05
		II	2	5	
		N/A	4	1	
Group M	Vocal cord movement (Observer 2 & 4)	I	28	1	
		II	6	1	
		N/A	5	0	

Figures 2 and 3 compare the haemodynamic changes just prior to direct laryngoscopy or Airtraq laryngoscopy and every minute for five minutes after vocal cord assessment in both groups. The haemodynamic changes in both the groups are similar with both equipment (Repeated measures ANOVA).

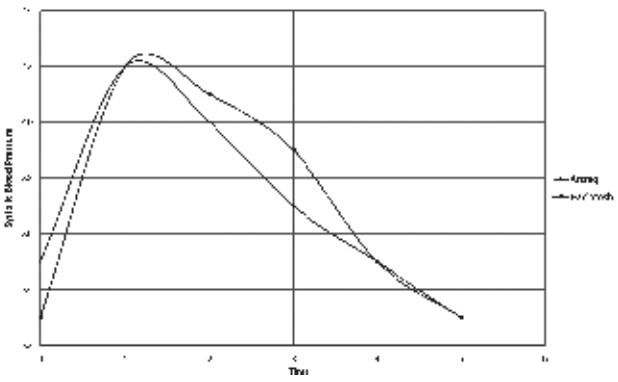

Figure 2: Changes in systolic blood pressure in both groups

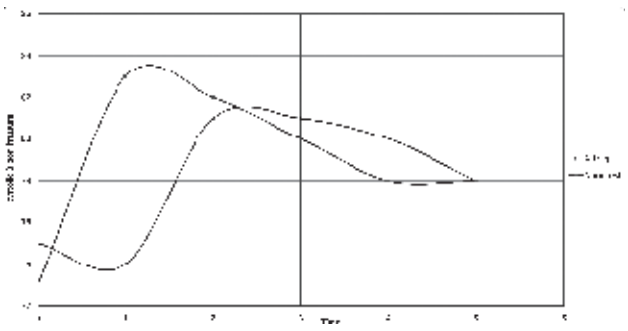

Figure 3: Changes in heart rate between the groups

Neither method of laryngoscopy was associated with recall of the extubation period when the patients were questioned two hours after extubation.

One patient in group A, whose vocal cord palsy went undetected, developed stridor in the postoperative ward after a period of 60-90 minutes following the surgery. She was immediately reintubated, as she had begun to desaturate, and was subsequently diagnosed with bilateral vocal cord palsy requiring tracheostomy followed by surgical repair of the vocal cords.

There were no incidents of stridor, laryngospasm, desaturation, and reintubation in the immediate postoperative period in the operating room during the vocal cord assessment.

Discussion

Thyroid surgery, albeit not as risky as it was earlier, still results in postoperative complications in a number of cases. Recurrent laryngeal nerve (RLN) injury, which could lead to vocal cord paralysis, is the second most common early complication of thyroidectomy.[1,2] If the RLN nerve is identified on time, the immediate complications of vocal cord paralysis including aspiration, respiratory obstruction and stridor, can be avoided. To do this, a laryngoscopy is requested after surgery to obtain an accurate status of the vocal cords. In accordance to the clinical findings, further interventions can also be planned.[3]

Direct laryngoscopy with a Macintosh laryngoscope is the most commonly used technique.[4] However, postoperative assessment of the vocal cords with this device is difficult, often causes nausea, severe discomfort in the patients and considerable haemodynamic changes, possibly precipitating haemorrhage. The current study was planned to systematically ascertain whether the Airtraq could be a better alternative to the Macintosh laryngoscope. On the 5-point reactivity scale to assess patient discomfort, patients were more comfortable with the Airtraq than the Macintosh laryngoscope. This is similar to the findings of Kundra *et al* who compared patient discomfort with the Macintosh laryngoscope and a fibreoptic endoscope. They too found patients to have significant discomfort during direct laryngoscopy when compared with nasal fibreoptic endoscopy.[5]

The haemodynamic responses associated with laryngoscopy using Airtraq were similar to those using the Macintosh. Three other studies[3,6,7] focusing on the Airtraq demonstrated that it produces less haemodynamic stimulation than other devices. These findings are corroborated with that of a meta-analytical study[8] conducted by Lu *et al* who systematically reviewed twelve randomised controlled trials published between 2006 and 2011. Further, Bensghir *et al* reported that in their study, patients in the X-Lite and Direct groups showed more haemodynamic variations than those in the Airtraq group.[9] These studies had concluded that

this is probably because the Airtraq requires less force to be applied during intubation.

The current study recorded the duration of a single laryngoscopy attempt in seconds - from the time the anaesthesiologist inserted the laryngoscope into the mouth to visualisation of vocal cords. This duration was found to be significantly longer ($p < 0.001$) with the Airtraq when compared to the Macintosh laryngoscope. This is because it takes longer to introduce the Airtraq into the mouth. This is contrary to the study by Bensghir *et al* which observed that the Airtraq and X-Lite laryngoscopes decreased time taken for intubation when compared with direct laryngoscopy.[9] Lu *et al*, in their meta-analysis, also concluded that Airtraq significantly decreased intubation time both in novice and in experienced anaesthetists compared with conventional Macintosh laryngoscopy.[8]

The reduced haemodynamic responses as well as the reduced number of attempts required for successful laryngoscopy seen with Airtraq compared to Macintosh laryngoscopy in these studies were all under anaesthesia. In an awake patient, the advantage of reduced haemodynamic responses to Airtraq could not be demonstrated. Nasal fibreoptic endoscopy does not produce such haemodynamic changes.[5]

It must be noted, however, that despite the duration of laryngoscopy being longer with Airtraq than Macintosh laryngoscope in this study, the patients were more comfortable with the Airtraq possibly because the retraction of the tongue was less.

Accuracy of vocal cord assessments was determined by the agreement in the assessments by the anaesthesiologist and the surgeon immediately after surgery, and their comparison to the assessment of ENT surgeon 72 hours later. Observer 2 and 4 were in agreement with respect to the assessment and grading of vocal cord mobility in all the cases.

There was a change in assessment conducted by ENT surgeon 3 days after operation in nine patients - 2 from group A and 6 from group M, were initially diagnosed to have unilateral vocal cord palsy were proven to be fully functional by the ENT surgeon 3 days later. This may not have been inaccuracy in assessment but could have been due to a temporary nerve palsy resulting from vocal cord oedema, neurapraxia etc. Chung-Yau Lo *et al* had reported that 93% of the patients who developed unilateral cord paralysis after thyroidectomy, recovered completely.[10] One patient in group M, who was diagnosed to have no vocal cord palsy, was later diagnosed to have unilateral vocal cord palsy by the ENT surgeon. This can be attributed to lower sensitivity of the Macintosh laryngoscope. Kundra *et al* in his study had observed that the Macintosh could detect vocal cord palsy with only 50% sensitivity and 88% specificity, while a fibreoptic endoscope could detect vocal cord palsy with 87.9% sensitivity and 98.9% specificity.[5]

The patient reactivity score had to be assessed by watching the patient's reaction to the equipment used. Thus, the observer could not be blinded to the equipment used and was a limitation in this study.

Conclusions

Comparison of assessment of vocal cord mobility following thyroid surgery using Macintosh and Airtraq laryngoscope shows that both devices provide similar conditions and accuracy for assessment of vocal cords. Patients are more comfortable during assessment when Airtraq is used. Patients do not seem to recall the laryngoscopy with either equipment or of the extubation period.

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