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Research Article

Comparative Evaluation of Hemodynamic Responses and Ease of Intubation with Tuoren Video Laryngoscope Vs Macintosh Laryngoscope in Patients Undergoing Coronary Artery Bypass Graft Surgery

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Abstract

Background: Cardiac patients are highly vulnerable to the hemodynamic alterations that follow the laryngoscopy and endotracheal intubation making it beneficial to use methods which can mitigate these effects. This randomized study aimed to compare the efficacy and associated hemodynamic variations between the Macintosh and Tuoren Videolaryngoscope for airway management in patients undergoing coronary artery bypass graftingsurgery.

Method: 60 patients undergoing elective CABG were evenly distributed into Group A (Tuoren Video laryngoscope) and Group B (Macintosh laryngoscope). Hemodynamic parameters, including systolic blood pressure (SBP), diastolicblood pressure (DBP), mean arterial pressure (MAP), pulse rate (PR), rate-pressure product (RPP) and peripheral oxygen saturation ($SpO2$) were recorded. Laryngoscopy and intubation time, ease of intubation assessed by Krieg's scale, and intubation difficulty score (IDS) were documented.

Results: There was a greater increase in hemodynamic parameters in group B from 1 minute followingintubation until 5 minutes ($p<0.05$). Group A provided better glottic visualisation as assessed by CL grade ($p<0.05$) in significantly shorter laryngoscopy time ($p=0.001$). Group A had a significantly lower Krieg's score ($p=0.02$) and IDS ($p=0.04$) than group B. The total intubation time, number of attempts, and complications were comparable between both groups, but the need for stylet was higher in group A ($p=0.04$).

Conclusion: The use of Tuoren video laryngoscope has been associated with faster laryngoscopyand improved glottic visualization, contributing to reduced hemodynamic alterations duringintubation but using a stylet is recommended to enhance the first-attempt successrate during intubation.

Keywords: Hemodynamic, Tuoren Videolaryngoscope, IDS, Krieg's Scale

INTRODUCTION

Laryngoscopy and endotracheal intubation are pivotal steps in inducing general anesthesia. However, despite their benefits, these procedures often involve significant hemodynamic alterations, which raise concerns, particularly among patients with underlying cardiovascular complications and those undergoing CABG surgery.[1]

The process of laryngoscopy triggers profound cardiovascular effects. Stimulation of the supraglottic region by the laryngoscopic blade prompts the sympathoadrenal response leading to increased catecholamine levels, primarily norepinephrine.[2-3] while these responses may be transiently manageable in healthy individuals, it cause significant risk for those with pre-existing hypertension, myocardial insufficiency or cerebrovascular disease potentially resulting in serious complications like MI, cardiac failure, ICH and increased ICP.[4-5]

Endotracheal intubation is considered the gold standard for patients undergoing CABG surgery. Macintosh laryngoscope has been vividly used since its invention. Tuoren video laryngoscope is a relatively new airway device resembling the Macintosh blade but with the addition of a micro camera at the tip of the blade. It uses optical principles of light refraction to offer clear views even in cases of anteriorly placed larynx without the need to align oral-pharyngeal-laryngeal axes.

This study aims to compare the use of a video laryngoscope with a classic Macintosh laryngoscope in terms of hemodynamic variations and ease of intubation in CABG patients, as these group of patients are most affected by the variation in hemodynamic alterations. We also planned to assess the laryngoscopy view by CL grade, IDS and complications between the two groups

MATERIAL AND METHODS

After obtaining approval from the Ethics committee and Institutional Review Board and registering in the Clinical Trials Registry (CTR1/2023/07/055215), in this prospective randomized study, 60 consenting patients aged between 35 and 75 years, undergoing elective CABG were randomized into two groups (30 each), either Tuoren or Macintosh groups using a computer-generated random numbers table (figure 1). Concealment of allocation was done using sequentially numbered, sealed and opaque envelopes.

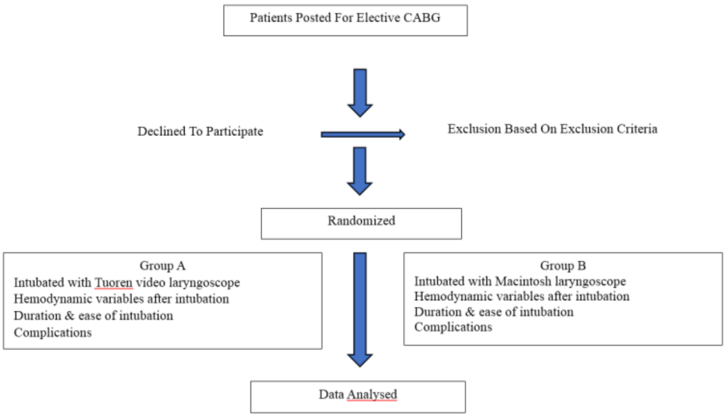

Figure 1. CONSORT Flow Diagram

All patients undergoing CABG, belonging to the ASA Grade 3, with ejection fraction>40%, age group between 35 and 75 years with a Mallampati score up to Grade 3, thyro-mental distance >6 cm, and mouth opening > 3 cm were included in the study.

The patients with associated valvular heart disease, pulmonary artery hypertension and left main disease, conduction abnormality, on permanent pacemaker, and emergency procedures were excluded from the study. Furthermore, those patients with anatomic features predictive of a difficult airway, Mallampatti score of 4, history of reactive airway disease, obesity (BMI >35 kg/m*), gastroesophageal reflux, and vital organ dysfunction (creatinine >2 mg/dl, bilirubin >2 mg/d, and liver enzymes > 3 times normal and bleeding diathesis) were excluded from our study.

Patients were kept nil by mouth (NBM) for 6 hours before surgery. Tablet alprazolam 0.5 mg was given to all patients orally one day before surgery. After arrival in the operating room, an 18G/20G peripheral intravenous catheter was inserted into the patient's forearm and IV fluid Ringer lactate was started.

Baseline parameters (spO_2, SBP/DBP, MAP, PR, RPP) were recorded and a train of four (TOF) monitor was attached. Rate pressure product (RPP) was calculated by multiplying SBP and PR. Standard multichannel monitoring was used throughout theprocedure, including invasive blood pressure using an arterial line, electrocardiograph (ECG), pulse oximetry (SPO2) and end-tidal carbon dioxide ($etco_2$).

All patients were pre-oxygenated with 100% oxygen for 3 minutes. Pre-medication was given midazolam 0.05 mg/kg, fentanyl 4ug/kg and anaesthesia induced with inj. etomidate 0.3mg/kg in slow incremental dose and adequacy of mask ventilation noted.

After confirming adequate mask ventilation, inj. rocuronium 0.9 mg/kg IV was administered for neuromuscular blockade. When the train of four response showed zero twitch, in group B, Macintosh laryngoscope was inserted into the right side of the mouth, sweeping the tongue to the left with the patient in sniffing position and head elevated by 3-7 cm and in group A video laryngoscope was inserted using a midline insertion technique in a neutral neck position. In both groups, the female patients were intubated with an endotracheal tube of 7 mm or 7.5 mm and male patients were intubated with an endotracheal tube of 8 mm or 8.5 mm. The endotracheal tube cuff was inflated and the tube was then connected to the breathing circuit and fixed with adhesive tape. All intubations were done by consultant having >3years of experience with Macintosh laryngoscope and had done atleast50 intubations with Tuoren video laryngoscope.

Effective ventilation was confirmed by square capnographic waveform and bilateral thoracic movements, and equal air entry was checked bilaterally.

In all patients, hemodynamic parameters (HR, SBP/DBP, MAP, SpO_2, RPP) were recorded at baseline (T_1), after induction but prior to relaxant (T_2), after relaxant but prior to intubation (T_3), 1min (T_4), 2min (T_5), 3min (T_6), 4min (T_7), 5min (T_8) after intubation. First attempt success rate, use of manoeuvres (repositioning of head of the patient, need for external laryngeal manipulation and usage of stylet), number of intubation attempts, Krieg's score (Table 5), laryngoscopy time, time taken to intubate after glottic view and total intubation time, Intubation difficulty score (IDS) (Table 6) and complications (oral trauma & bleed & dental injury) were recorded.

The "5-min" data collection period after endotracheal intubation was included based on stress responses observed in the previous studies.[6] Duration of laryngoscopy was defined as "the time from insertion of laryngoscope blade into the mouth to getting the best view of the glottis." Duration of intubation was defined as "the time from insertion of laryngoscope into the mouth to obtaining three capnographic waveforms after intubation." An attempt was defined as "insertion of laryngoscope into the mouth to its removal." Three attempts were permitted in all cases if required. More than three attempts to intubate or "intubation taking more than 120s" was considered as "failed intubation." $ETCO_2$ was maintained within 35±5 mmHg to avoid the effects of hypercarbia or hypocarbia. Neither was any procedure done nor were any other drugs administered during the data collection period after tracheal intubation. Subsequent management was left to the discretion of the anesthesiologist providing care for the patient.

Statistical Analysis & Sample Size

A sample size of 60 (30 in each group) was calculated at 80% study power and alpha power 0.05, assuming an SD of 26.01 mm of Hg in SBP at 8 minutes of induction, as found in the previous article.[6] Chi-square test was employed for inter-group comparison of categorical data and continuous variables were compared using independent t-test. P value <0.05 were considered significant.

RESULTS

Table 1. Demographic Data and Pre-Operative Parameters

Demographic Variables	Group A (Tuoren Video Laryngoscope)	Group B (Macintosh Laryngoscope)	P-Value
Age (yrs)	57.40 ± 7.09	58.20 ± 7.14	0.66
Sex (M:F)	22:8	21:9	0.78
Weight (kgs)	63.53 ± 8.26	68.23 ± 9.05	0.06
Mouth opening (3/>3 fingers)	7/23	7/23	0.59/0.8
Mallampati grade (1/2/3)	10/13/7	12/12/6	0.59/0.8/0.76

Table 2. Laryngoscopy & Intubation Assessment Parameters

	Group A (Tuoren Video Laryngoscope)	Group B (Macintosh Laryngoscope)	
CL grade (1/2/3)	30/0/0	18/8/4	0.001/0.002/0.04
Laryngoscopy time (sec)	7.07 ± 2.42	10.01 ± 3.42	0.001
Time to intubate after glottic view	18.13 ± 9.79	14.4 ± 8.27	0.11

(sec)			
Total intubation time (sec)	25.2 ± 12.38	24.5 ± 11.7	0.9
Attempts (1/2/3)	25/5/0	27/3/0	0.52/0.63
Alternate technique (stylet)	10	3	0.03

Table 3. Haemodynamic Parameters

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
SBP (mmHg)								
Group A	125.31 (5.93)	118.91 (4.55)	115 (7.22)	138.97 (6.24)	135.71 (7.08)	130.91 (6.24)	126.83 (6.84)	120.6 (4.62)
Group B	123.86 (9.2)	120.6 (4.6)	116.17 (6.93)	144.26 (7.28)	142.06 (6.76)	139.43 (6.71)	136.86 (6.63)	125.43 (6.11)
P-value	0.43	0.12	0.53	0.001	0.001	0.001	0.001	0.002
DBP (mmHg)								
Group A	74.74 (5.5)	72.49 (6.6)	69.08 (4.32)	87.6 (5.1)	84.8 (6.63)	80.8 (5.17)	77.6 (4.7)	74.2 (5.6)
Group B	76.26 (6.04)	73.49 (4.65)	70.21 (5.53)	94.34 (6.88)	91.6 (6.57)	87.11 (8.42)	84.26 (6.64)	78.8 (6.2)
P-value	0.27	0.46	0.41	0.002	0.001	0.001	0.001	0.003
MAP (mmHg)								
Group A	91.6 (4.8)	88.43 (4.83)	86.23 (5.12)	104.7 (4.89)	101.7 (6.13)	97.5 (4.89)	94.01 (5.07)	92.65 (6.88)
Group B	92.12 (6.75)	88.48 (5.42)	86.82 (3.91)	110.92 (6.68)	108.42 (6.4)	105.22 (6.45)	102.46 (6.43)	96.01 (5.14)
P-value	0.70	0.68	0.62	0.001	0.001	0.001	0.001	0.003
PR (per minute)								
Group A	88.9 (1.9)	77.56 (6.86)	73.48 (7.8)	93.51 (4.6)	89.91 (2.82)	86.71 (6.74)	84.55 (5.41)	84.16 (4.17)
Group B	87.8 (10.7)	77.82 (5.49)	74.5 (2.89)	101.58 (3.5)	97.76 (1.89)	95.73 (8.1)	92.93 (9.93)	87.73 (6.81)
P-value	0.74	0.83	0.64	0.001	0.001	0.001	0.001	0.003

Figure 2. Rate Pressure Product (RPP)

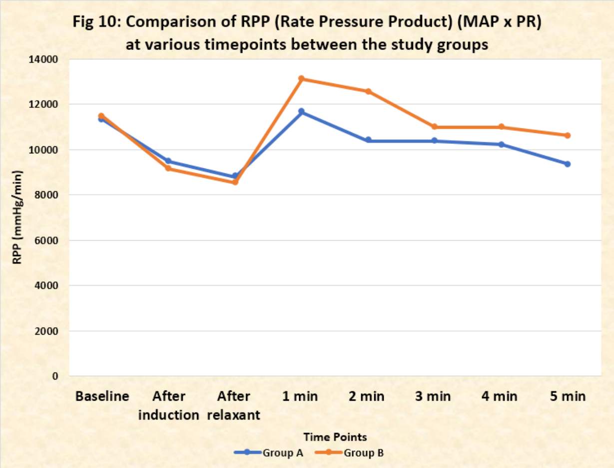

Table 4. Ease of Intubation, IDS & Complications

Parameters	Group A (Tuoren Video Laryngoscope)	Group B (Macintosh Laryngoscope)	P-Value
Krieg's score (3-4/5-6/7-10)	30/0/0	25/5/0	0.02
IDS	0.53 ± 0.82	1.26 ± 1.20	0.04
Complication (oral & tongue bleed/ teeth injury)	2/0	3/1	0.65/0.32

The demographic data including age, sex & weight along with mouth opening and Mallampati grade were comparable between the two groups (P>0.05) (Table 1). Video laryngoscope provided a significantly better laryngoscopic view (CL grade I even in patients having MPG III) compared to the Macintosh group. The video laryngoscope group required significantly less time to provide the best glottic view in the Macintosh group. Although the time taken to intubate after getting an excellent laryngoscopy view was longer in the video laryngoscope group, total intubation time in both groups was comparable (Table 2). The first attempt success rate of intubation was comparable between both groups. The number of patients intubated with the aid of stylet was significantly higher in the video laryngoscope group 10 (33%) than in Macintosh group 3 (10%) (P=0.03) (Table 2).

Table 3 shows hemodynamic parameters at various time intervals. Both groups had comparable parameters at baseline (T_1), T_2, and T_3. Group B had significantly higher hemodynamic parameters from 1 min till 5 min post intubation. Fig 2 shows significantly higher RPP in group B compared to group A from T_4 to T_8. All patients in the video laryngoscope group had Krieg's score between 3-4 which shows the ideal intubating condition while 25 patients had an ideal intubating condition in group B. 5 patients had a score between 5-6 i.e, good intubating condition.

Group A had a significantly lower IDS score than group B. Complications were higher in group B but were statistically not significant.

DISCUSSION

Cardiac patients have increased catecholamines concentration and increased sensitivity of peripheral vessels catecholamines, leading to an exaggerated response to laryngoscopy and endotracheal intubation. In addition to the hemodynamic responses, CAD patients have atherosclerotic changes in arterial vasculature and microcirculatory insufficiency to the laryngeal nerves. This may cause airway tissues to be more susceptible to mechanical damage and pressure from endotracheal intubation.[7-9] Thus, it is important to emphasize choosing a device which aids in the smooth conduction of laryngoscopy and intubation.

The present study found that video laryngoscope causes a lesser rise in hemodynamic parameters along with decreased duration of laryngoscopy & IDS. The hemodynamic changes were seen immediately after laryngoscopy & intubation, with the maximum rise in parameters after 1 and 2 min post-intubation.

The Tuoren video laryngoscope has a non-channelled blade and comes with blades of various sizes, having a light source at the end that is powered by a battery. The high-resolution power of its camera provides a clear view of the glottis and surrounding structures without the need to apply external force to align the oral, pharyngeal and tracheal axes. The neutral position of the head, less traction on the mandible and less requirement of lifting force are expected to cause less sympathetic stimulation along with less trauma.[10-12]

In our study, the hemodynamic parameters were better preserved in the video laryngoscope group. The Macintosh laryngoscope resulted in a greater rise in SBP, DBP, PR, MAP & RPP post laryngoscopy and intubation, similar to the study conducted by AV Varsha[6]&Sarlikar G et al.[13]This difference was attributed to the increased manipulation required with the Macintosh laryngoscope, necessitating adjustments to the oral-pharyngeal-laryngeal axes for optimal utilization, unlike the Tuoren video laryngoscope. This forceful alignment led to sympathetic stimulation, causing an increase in hemodynamic parameters. Contrary to our study, Soliman R et al[14]found that glidoscope video laryngoscope caused more rise in hemodynamic parameters, which may be due to their increased laryngoscopy time, which led to longer contact of glidoscope blade with oropharyngeal mucosa receptor, thus producing a greater stress response.

RPP is the index of myocardial oxygen consumption. MI may be possible with a RPP value of more than 22000.[15] In our study, both the video laryngoscope and Macintosh group had RPP values below 15000 at all measured intervals hence, both these laryngoscopes are safe to be used and the video laryngoscope with significantly lower RPP was safer. This was consistent with the findings of Dashti M et al.[16]

Likewise the findings of CD Wallace et al[17],in our study, both groups had similar mouth opening and Mallampati grade, but the video laryngoscope group had significantly better CL grade due to the excellent glottic view provided by video laryngoscope, which also resulted in greater ease of intubation as assessed by Krieg's score comprising laryngoscopy condition, vocal cord position & coughing reflex as criteria. This strengthens the role of a video laryngoscope in difficult airway scenarios.

Despite having significantly lesser laryngoscopy time in the video laryngoscope group, both groups had comparable total intubation time due to the longer time taken to insert the ETT in the video laryngoscope group after getting an excellent glottic view. The tube could be advanced more easily into the trachea when the laryngoscope blade was withdrawn by 1-2 cm and the handle rotated caudally with a slight rotation towards the left. The higher incidence of the need for stylet in the video laryngoscope group also contributed to this increase in time.

The IDS is a comprehensive measurement of difficult intubation. It comprises seven parameters (Table 2). The lower mean IDS in the video laryngoscope indicates easier laryngoscopy and intubation. Though the number of attempts & use of stylet was more in the video laryngoscope group but the need to apply extra laryngeal pressure and lifting force in the Macintosh group outrun the mean total IDS score of video laryngoscope group. This was consistent with the finding of Samal RL et al.[18]

Though statistically non-significant, Macintosh group has a higher number of patients expressing complications which was due to the need to put undue pressure on gums, teeth and para glottic structures for maximal exposure of vocal cords thus leading to trauma.

Limitations of our study include absence of blinding of intubating anaesthetist leading to bias. We had excluded patients having predicted difficult airway and mouth opening < 3cm making it difficult to demonstrate the use of both devices in case of difficult airway situations

CONCLUSION

The laryngoscopy and intubation with Tuorenvideolaryngoscope resulted in significantlylesser hemodynamic alterations than with Macintosh laryngoscope. Also, video laryngoscope group had a lower IDS, a comparable intubation time and greater ease of intubation. Thus, we conclude that the Tuoren video laryngoscope is a superior option to Macintosh in patients with ischemic heart disease planned for CABG surgery in experienced hands.

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REFERENCES

1. Barman TK, Ghosh K, Sen C, et al. A comparative study of haemodynamic responses to laryngoscopy and endotracheal intubation with direct laryngoscope and video laryngoscope in patients posted for coronary artery bypass grafting. J. Evolution Med. Dent. Sci. 2017;6(16): 1248-1252.
2. Shribman AJ, Smith G, Achola KJ. Cardiovascular and catecholamineresponses to laryngoscopy with and without tracheal intubation. Br JAnaesth1987;59:295-9.
3. Kahl M, Eberhart LH, Behnke H, et al. Stress response to tracheal intubation in patients undergoing coronary artery surgery: direct laryngoscopy versus an intubating laryngeal mask airway. J Cardiothoracic VascAnesth 2004;18(3):275-80.
4. Reid LC, Brace DE. Irritation of the respiratory tract and its reflex effect upon heart. SurgGynaecol Obstet. 1940;70: 157-62S.
5. Hagberg CA. Artime CA. Airway Management in Adults: Miller's Anesthesia.Miller RD, Cohen NH, Erikson LI, Fleisher LA, Wiener-Kronish JP, YoungWL. 8th Ed.; 2015,1:1647-1680.

6. Varsha AV, George G, Pillai R, Sahajanandan R. Comparative evaluation of hemodynamic responses and ease of intubation with Airtraq video laryngoscope versus Macintosh laryngoscope in patients with ischaemic heart disease. Ann Card Anaesth2019;22:365-71.
7. Aghdaii N, Azarfarin R, Yazdanian F, et al. Cardiovascular responses to orotracheal intubation in patients undergoing coronary artery bypass grafting surgery. Comparing fiberoptic bronchoscopy with direct laryngoscopy. Middle East Anesthesiol 2010;20(6):833-8.
8. Kanchi M, Nair HC, Banakal S, et al. Haemodynamic response to endotracheal intubation in coronary artery disease: direct versus video laryngoscopy. Indian J Anaesth 2011;55(3):260-5.
9. Gavrilovska-Brzanov A, Jarallah MA, Cogliati A, Mojsova-Mijovska M, Mijuskovic D, Slaveski D. Evaluation of the Hemodynamic Response to Endotracheal Intubation Comparing the Airtraq(®) with Macintosh Laryngoscopes in Cardiac Surgical Patients. Acta Inform Med. 2015 Oct;23(5):280-4.
10. Lu Y, Jiang H, Zhu YS. Airtraq laryngoscope versus conventional Macintosh laryngoscope: a systematic review and meta-analysis. Anaesthesia. 2011; 66: 1160-1167.
11. Maharaj CH, Costello JF, Harte BH, Laffey JG. Evaluation of the Airtraq and Macintosh laryngoscopes in patients at increased risk for difficult tracheal intubation. Anaesthesia 2008;63:182-8.
12. Maharaj CH, Buckley E, Harte BH, Laffey JG. Endotracheal intubation in cervical spine immobilization: A comparison of Macintosh and Airtraq. Anaesthesia 2007;107:53-9.
13. Sarkilar G, Sargın M, Sarıtaş TB, Borazan H, Gök F, Kılıçaslan A, Otelcioğlu Ş. Hemodynamic responses to endotracheal intubation performed with video and direct laryngoscopy in patients scheduled for major cardiac surgery. Int J Clin Exp Med. 2015 Jul 15;8(7):11477-83.
14. Soliman R, Mofeed M, Alamoudy O, Farouk A. A prospective randomized comparative study between Macintosh and Glidescope in adult patients undergoing cardiac surgery. Egypt J CardiothoracAnesth2015;9:8-13.
15. Robinson BF. Relation of heart rate and systolic blood pressure to the onset of pain in angina pectoris. Circulation 35 (1967):1073-1083.
16. Dashti M, Amini S, Azarfarin R, et al. Hemodynamic changes following endotracheal intubation with Glidescope® video-laryngoscope in patients with untreated hypertension. Res Cardiovasc Med 2014;3(2):e17598.
17. Wallace C, Foulds L. A comparison of the ease of tracheal intubation using a McGrath MAC laryngoscope and a standard Macintosh laryngoscope. Anaesthesia. 2015; 70:1281-1285.
18. Samal RL, Swain S, Samal S. A Comparative Study between Truview PCD Video Laryngoscope and Macintosh Laryngoscope with Respect to Intubation Quality and Hemodynamic Changes. AnesthEssays Res. 2021;15(1):73-80.

Annexure 1
Distribution of Study Participants According To Krieg's Score

Points	1	2	3	4
Laryngoscopy	Easy	Good	Difficult	Impossible
Vocal cords	Open	Move	Closing	Closed
Coughing Reflex	Absent	Diaphragm move	Weak	Strong
Total score	3-4	5-7	8-10	11-12
Class	I	II	III	IV
Intubating conditions	Excellent	Good	Poor	Inadequate

Annexure 2
Intubation Difficulty Score (IDS)

Parameter	Points

Number of supplementary attempts >1	N_1
Number of supplementary operators >1	N_2
Number of alternative techniques	N_3
Cormack-Lehane grade minus one	N_4
Lifting force required	
Normal	$N_5=0$
Increased	$N_5=1$
Laryngeal Pressure	
Applied	$N_6=0$
Not applied	$N_6=1$
Vocal Cord mobility	
Abduction	$N_7=0$
Adduction	$N_7=1$