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Original Research Article

Comparative evaluation of intubation difficulty score using C-Mac video-laryngoscope and macintosh laryngoscope in obese patients undergoing general anaesthesia

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ABSTRACT

Background: Obesity, a global epidemic, predicted to have difficult airways which can be evaluated preoperatively with advancement of technologies for airway management. The present prospective study was done to evaluate and compare the intubation difficulty score (IDS) in videolaryngoscope with standard Macintosh laryngoscope.
Methods: Our study included 50 obese patients divided into two groups: Group OC (intubation done with C-Mac videolaryngoscope) and Group OM (Macintosh laryngoscope). The patients were evaluated for macroglossia, upper lip bite test, modified Mallampati grade, inter incisor gap and Wilson score in preoperative period. Intraoperatively IDS, time taken for intubation and complications were studied.
Results: IDS has sensitivity and specificity of 82.3% and 66.67% respectively. 12 patients in OM group and 3 in OC group had very difficult IDS (48% vs. 12%; p <0.05). Mean time taken for intubation was more in OM group (26.08 +/- 9.8 secs) as compared to OC group (15.96 +/- 7.2 secs). Inter incisor gap grade 2 have 8.3% of patients in easy IDS, 30.4% moderately difficult and 53.3% in very difficult IDS (p<0.05). Very difficult IDS group had total Wilson score of 5.60 as compared to 4.52 in moderately difficult group and 3.17 in easy IDS group.
Conclusions: This study reveals that as compared to standard Macintosh laryngoscope, C-Mac videolaryngoscope is better for intubation in obese patients in terms of IDS. Time taken for intubation and complications are less with videolaryngoscope. Inter incisor gap and Wilson score measured pre operatively are significant predictor of difficult airway in relation with IDS.

Keywords: C-mac videolaryngoscope, Intubation difficulty score, Inter incisor gap, Obesity, Wilson score

INTRODUCTION

The global epidemic 'Obesus,' poses challenges for anaesthesia practitioners. While traditional indices and user-rated scores offer some insight, they don't provide a comprehensive picture. Despite the simplicity of the standard Macintosh laryngoscope, video laryngoscopy-assisted tracheal intubation is increasingly favoured for managing difficult airways. Adnet et al introduced the Intubation Difficulty Score (IDS), a quantitative measure based on seven parameters linked to challenging intubation.[1] This study is designed to compare IDS in obese patients undergoing intubation with video laryngoscope versus the standard Macintosh laryngoscope.

This study aimed to evaluate and compare the Intubation Difficulty Score (IDS) using C-Mac videolaryngoscope and Macintosh laryngoscope in obese patients posted for surgery under general anaesthesia and to correlate airway

indices: interincisor gap, modified Mallampati grade, upper lip bite test, macroglossia, NC/TMD ratio and Wilson score with intubation difficulty score in obese patients. Also, to compare the Time Taken for Intubation (TTI) in C-Mac video laryngoscopy and Macintosh laryngoscopy in obese patients. Moreover, to compare the respiratory, cardiovascular complications and oropharyngeal trauma during post intubation period with C-Mac and Macintosh laryngoscope in obese patients.

METHODS

A double blind, prospective observational and comparative study was conducted after approval from the institutional ethics committee and review board (TS/MSSH/MOHALI/HBPL/IEC/ANAES/19-05) and written informed consent from the patients. It is a single hospital based study done in MAX Superspeciality Hospital, Mohali for a period of 1 year (June 2019-May 2020) in obese patients who underwent general anaesthesia for surgical procedure. The patient and the observer were blinded to group allocation for removing observational bias.

Fifty patients with age ≥18 years of either sex and body mass index>30kg/m^2 undergoing elective surgery under general anaesthesia were randomised prior to surgery using computer generated random number contained in opaque sealed envelope into either Group OC (intubation with C-Mac video laryngoscope) or Group OM (intubation with conventional Macintosh laryngoscope). Patients who refused to give consent, patients with history of reactive airway, upper airway pathology, known hypersensitivity to intravenous anaesthetic agents were excluded from the study.

Sample size was calculated by taking 11 sec as clinically relevant difference in intubation time (mean in group 1 μ1 = 14.9, mean in group 2 μ2 = 26.32) with common Standard Deviation of 13 sec from the study by Ahmed et al.[2] Using type 1 error α = 0.05 and type2 error β 0.2, it was required to include 25 patients per group after considering 10% dropout rate. According to power analysis, at least 21 patients are required in each group to compare the intubation difficulty score with statistical power 80% and CI 95%.

Procedure

The day before surgery, all patients were seen by the observer anaesthesiologist blinded to group allocation, for a detailed history and physical examination. Demographic details, age, gender, BMI (kg/m^2), comorbidities, American Society of Anaesthesiologist (ASA) status and history of any previous surgery with difficult airway and its details were documented.

Airway examination included: Macroglossia, presence of beard in males, aberration in teeth, upper lip bite test-ability of lower incisors to cover the upper lip was observed. Mouth opening was assessed by finger test. Thyromental distance (TMD) - Patient was asked to sit with fully extended neck and closed mouth. With the help of measuring tape, distance between thyroid and symphysis-menti was measured. Neck circumference (NC) - Patient was asked to keep the shoulders low, but not to hunch and then distance between mid-cervical spine and mid anterior neck, just below the thyroid cartilage was measured. Modified Mallampati grade (MMP)- With the patient in sitting position, head protruding forward and sticking out the tongue while opening his mouth wide open, Observers eye were at the level of patients open mouth. Observing the degree to which the faucial pillars, uvula, soft palate and hard palate were visible, mallampati grading was done. Wilson score- 5 parameters (weight, mobility of head and neck, jaw movement, receding mandible and buck teeth) were used to calculate Wilson score.

After shifting patient to operation theatre, standard ASA monitors were attached including NIBP, 5 lead ECG and pulse oximetry. One wide bore cannula was secured. Preoxygenation with 100% oxygen was done in all patients for 3 minutes. Anaesthesia was induced with Injection fentanyl (2 mcg/kg), injection propofol (1.5-2.5mg/kg), injection atracurium (0.5mg/kg). After giving drugs for induction, bag and mask ventilation using 100 % O2 at 6 litres/min was started. During bag and mask ventilation, difficulty was assessed according to Han's grade by the anaesthetist. The patients were then intubated using either C-Mac videolaryngoscope or Macintosh laryngoscope according to their allocation.

The whole process of intubation was scored by seven variables (N1 to N7) of Intubation difficulty score (IDS). N1 represents the number of additional intubation attempts. N2 represents the number of additional operators. N3 is the number of alternative techniques used for intubation. N4 represents the laryngoscopic view, as defined by Cormack-Lehane grade: grade 1 = score 0, grade 2 = score 1, grade 3 = score 2, and grade 4 = score 3. N5 is the lifting force applied during laryngoscopy. N6 represents the necessity to apply external laryngeal pressure to optimize glottic exposure. N7 refers to vocal cord mobility. The IDS score was calculated as the sum of N1 through N7.

The time taken for intubation (TTI) was measured by using stop watch starting from the insertion of laryngoscope till the time when end-tidal CO2 was detected on the anaesthesia monitor.

Cardiovascular and respiratory parameters were noted down during postintubation time interval at 1, 3 and 5 min. Respiratory: any event of hypoxia (less than 90% spo2), value of EtCO2, laryngospasm, bronchospasm. Cardiovascular: episode of tachycardia (heart rate more than 100), arrhythmia, hypertension (BP more than 20% of patients baseline BP) will be seen. Anaesthesia was maintained with desflurane/sevoflurane (minimum

alveolar concentration{MAC} of 1-1.2) in mixture of nitrous oxide with oxygen (1:1), supplemented with atracurium and fentanyl top ups.

Statistical analysis

The data obtained was entered in MS excel spreadsheet. Data was analysed using SPSS V21. Categorical data was represented as frequencies and percentage; Chi square test was used as test of significance. Continuous data was represented as mean and standard deviation, for which Unpaired 't' test and ANOVA test were used. The p value at <0.05 was considered as 5% level of significance.

RESULTS

The demographic distribution, obesity grading of the studied population in 2 groups showed no statistically significant difference for these variables (p>0.05) (Table 1).

Table 2 represents the distribution of patients based on macroglossia, ULBT, IIG, NC/TMD, total Wilson score and HANS Grade based on IDS score. On performing ANOVA test, IIG, NC/TMD ration and Total Wilson score with IDS group were found to be statistically significant (p<0.05).

Table 1: Demographic distribution of the studied population.

Parameters		OC (%)	OM (%)	Sig.
Gender	Male	11 (44)	14 (56)	0.259
	Female	14 (56)	11 (44)	
Age (in years)		39.86±12.85	41.66±13.28	0.596
Weight (kg)		98.48±14.42	100.04±17.31	0.731
Height (cms)		164.64±7.86	162.64±6.87	0.343
BMI (kg/m^2)		36.30±4.61	37.80±5.66	0.311
ASA				
2		16 (64)	16 64)	>0.05
3		9 (36)	9 (36)	
Obesity				
Grade 1		11 (44)	9 (36)	>0.05
Grade 2		12 (48)	11 (44)	
Grade 3		2 (8)	5 (20)	

Table 2: Distribution of patients based on MACROGLOSSIA, ULBT, IIG, NC/TMD, Total Wilson score and HANS grade based on IDS score.

Parameters		Easy (%)	Moderate (%)	Very (%)	Sig.
Macroglossia	No	11 (91.1)	22 (95.7)	14 (93.3)	>0.05
	Yes	1 (8.3)	1 (4.3)	1 (6.7)	
ULBT	Class I	8 (53.3)	4 (25.0)	3 (15.7)	>0.05
	Class II	4 (26.7)	7 (43.7)	7 (36.8)	
	Class III	3 (20.0)	5 (31.2)	9 (47.3)	
MMP	Grade II	9 (75.0)	16 (69.6)	10 (66.7)	>0.05
	Grade III	3 (25.0)	7 (30.4)	5 (33.3)	
IIG	0 (>5 cms)	7 (58.3)	5 (21.7)	2(13.3)	<0.05
	1 (=5 cms)	4 (33.3)	11 (47.8)	5 (33.3)	
	2 (<5 cms)	1 (8.3)	7 (30.4)	8 (53.3)	
NC/TMD		6.5±0.90	6.4±0.54	6.9±0.49	0.079
Total Wilson score		3.1±1.46	4.5±2.08	5.6±1.95	0.008
HANS grade	I	5 (41.7)	10 (43.5)	2 (13.3)	>0.05
	II	5 (41.7)	6 (26.1)	11 (73.3)	
	III	2 (16.7)	7 (30.4)	2 (13.3)	

Table 3 showed the IDS score of the studied group. Majority of cases in OC group belonged to easy IDS group. Whereas majority of cases in OM group belonged to very difficult IDS group. On performing chi square test this difference was found to be statistically significant (p<0.05). Time taken for intubation was more in OM group (26.08 secs) as compared to OC group (15.96 secs), which was found to be statistically significant.

Mean arterial pressure was recorded at 1min, 3min and 5min. At all the three points mean values are higher in OM group as compared to OC group. However, that difference was statistically significant only at 1 min, but insignificant at 3min and 5min. Heart rate was recorded at 1min, 3min and 5min. At all the three points mean values are higher in OM group as compared to OC group. However, that difference was statistically significant only at 5 min, but insignificant at 1min and 3min. SpO2 was recorded at 1min, 3min and 5min. At all the three points mean values are higher in OC group as compared to OM group. However, that difference was statistically significant only at 5 min, but insignificant at 1min and 3min illustrated in Figure 1.

Table 3: Intubation difficulty score (IDS).

Parameters		OC (%)	OM (%)	Total (%)	Sig.
IDS	Easy	10 (40)	2 (8)	12 (24)	<0.05
	Moderate	12 (48)	11 (44)	23 (46)	
	Very difficult	3 (12)	12 (48)	15 (30)	
Time taken for incubation (secs)		15.9±7.24	26.08±9.83		<0.05

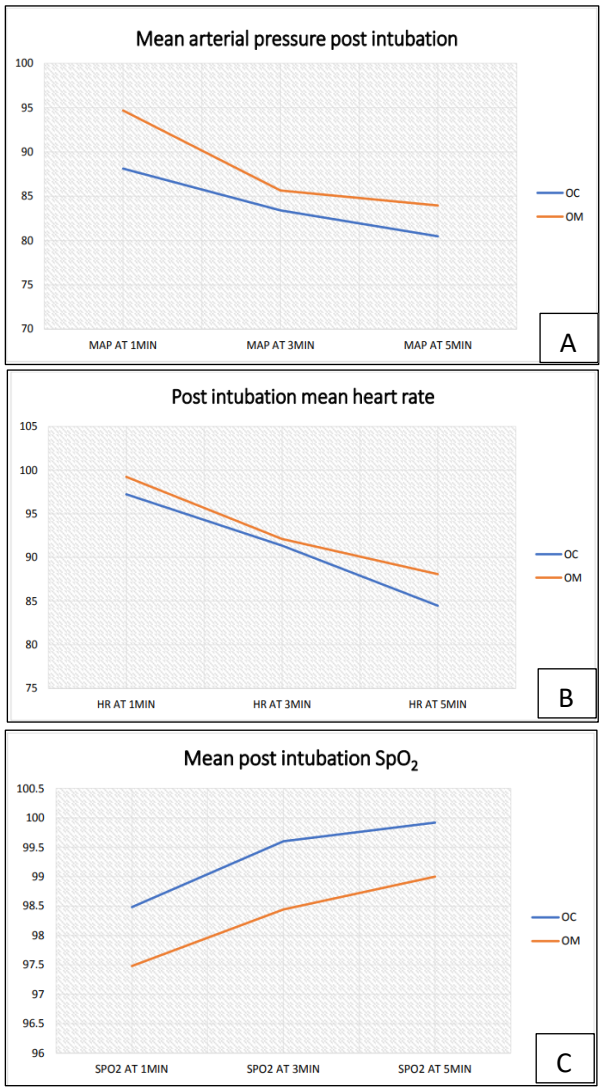

Figure 1: Comparison of a) Mean arterial pressure, b) Post intubation mean heart rate and c) Post intubation oxygen saturation between two groups at 1,3 and 5 minutes.

In OC group, 4% cases had bronchospasm as compared to 16% patients in OM group. None of the cases in OC group had trauma. But 8% cases each in OM group had lip trauma and tongue trauma, these all parameters were found to be not statistically significant (p value >0.05).

None of the cases in easy IDS group had history of trauma. 4.3% cases each in moderately difficult group and 6.7% cases each in very difficult group had lip trauma and tongue trauma. On performing chi square test, this difference was not found to be statistically significant (p value >0.05).

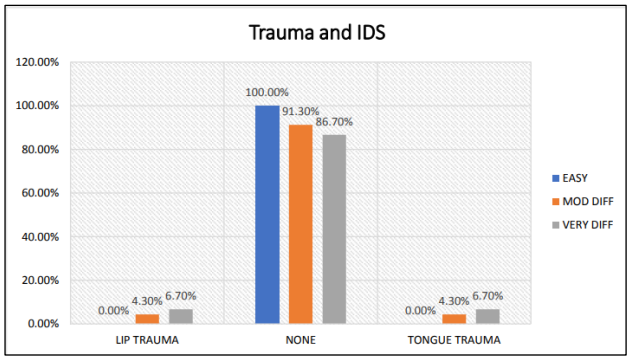

Figure 2: Comparison of incidence of oropharyngeal trauma with intubation difficulty score.

DISCUSSION

This study focuses on evaluating preoperative predictive factors for difficult airways in obese patients, including modified Mallampatti classification, inter-incisor gap, macroglossia, upper lip bite test, and Wilson score. These factors are examined in relation to the Intubation Difficulty Score (IDS), a quantitative measure combining parameters associated with difficult intubation.

Mean age in OC group was 39.8±12.8 years and in OM group was 41.6±13.2 years. There were 14 (56%) females, 11 (44%) males and 11 (44%) females and 14

(56%) males in OC and OM group respectively. 8% cases in OC group belonged to obesity grade 3 as compared to 20% in OM group. 48% cases in OC group belonged to obesity grade 2 as compared to 44% in OM group. The age, gender distribution and obesity grade were comparable and statistically non-significant (p>0.05).

In this study, total 3 patients (6%) out of 50 had macroglossia. We observed, 8.3%, 4.3% and 6.7% had macroglossia in easy, moderately difficult and very difficult IDS group respectively which was not found to be statistically significant (p>0.05). This is comparable with the study by Kim et al in which authors evaluated correlation between anatomy of upper airway (measured via CT) and ease of light wand-assisted endotracheal intubation in 153 non obese patients. Authors suggested that large tongue size was not significantly associated with the success and intubation timings.[3]

In our study 15,18 and 17 patients belong to upper lip bite test class I, II and III respectively. In class III ULBT, 20% had easy as compared to 31.2%, moderately difficult and 47.3%, very difficult IDS group. The test results were not statistically significant (p>0.05). ULBT also had low sensitivity (17.6%) and specificity (69.7%) in our study. The results were similar to two previously done studies. Eberhart et al in more than 1400 patient as subjects agreed that ULBT had a low sensitivity (28.2%) to predict difficult laryngoscopy.[4] Srinivasan et al in their study reported similar results, with low sensitivity of 5.88%, for ULBT predicting difficult airway.[5]

Inter incisor gap in this study was found to be statistically significant, grade 0 (>5 cms) had 14 (28.8 %) patients, grade 1 (= 5cms) had 20 (40%) patients and grade (<5 cms) had 16 (32%) patients out of the total 50 patients. 8.3% of patients in easy IDS. 30.4% patients in moderately difficult and 53.3% patients in very difficult IDS group had grade 2 IIG. Our observations were comparable to Narkhede et al in which 400 Indian patients were analysed in two set and observed that interincisor gap with 80.2% incidence is significantly associated with difficult intubation and concluded that it can correctly predict 80% of easy or difficult intubations.[6] Prakash et al in their study on 330 adults, analysed airway characteristics and association with difficult laryngoscopy. IIG was significantly associated with difficulty as Cormack and Lehane grade 3 and 4.[7]

We observed that, 25% of grade III MMPS belonged to easy IDS group as compared to 30.4% in moderately difficult IDS group and 33.3% in very difficult IDS group. The difference was notstatistically significant (p>0.05), with sensitivity and specificity of 35.2% and 72.7% respectively. Our study has shown similar results; attributing that MMP grade alone is a poor predictor for difficult airway. Lundstorm et al in their meta-analysis evaluated that modified mallampati grade is a poor indicator for difficult laryngoscopy and intubation.[8] Similarly, Budde et al in their study on airway predictors for difficultintubation in obese patients observed MMPS grade have poor to moderate sensitivity (20-62%) and moderate to fair specificity (82-97%).[9]

Very difficult IDS group had Wilson score of 5.60, as compared to 4.52 in moderately difficult group and 3.17 in easy IDS group. This difference was found to be statistically significant (p<0.05) in our study. These findings correlate with previous study, in which Sakrikar et al studied 352 Indian patients and suggested that Wilson's score, correctly predicted the patients who have difficult intubation which was statistically significant (p<0.01) in their study.[10] Wilson score also have a good true positive value as compared to modified mallampati grade and its calculation in pre anaesthesia examination preoperatively will help us to predict difficulty. Shelgaonkar et al evaluated the usefulness of Wilson score as a predictor for difficult airway. In 200 patients the study reviewed that, being seldom used, Wilson score (2/3) is a highly sensitive indicator for difficulty during intubation with Cormack-Lehane grade of III and IV.[11]

In our study, 16.7% in easy IDS group belonged to Hans grade III, as compared to 30.4% in moderately difficult and 13.3% in very difficult IDS group. There was no patient with Hans grade IV. The difference between three groups of IDS in relation to Hans grade of mask ventilation was not statistically significant (p>0.05). We evaluated that Hans grade III which is predictor of difficult mask ventilation is not related with the difficulty in intubation. To the best of my knowledge, there is no data published till date in which relationship of Hans grade for mask ventilation with intubation difficulty score has been studied.

In OC Group, 40 %, 48% and 12% had easy, moderate and very difficult IDS respectively. Whereas in OM Group (Macintosh) 8%, 44%, 48% had easy, moderate and very difficult IDS score, respectively. Siriussawakul et al in their study on more than 500 obese patients found that the IDS remains a good tool to evaluate DI among obese patients. The authors recommended that a score of 2 or higher is an optimal cut off point to indicate somewhat DI and a score of 5 or higher is an optimal cut off point to indicate DI.[12] In another study on obese parturient Eiamcharoenwit et al reviewed the performance of IDS and based on their analysis, IDS is reliable in defining difficult intubation in these patients with score of 5 or more higher as an optimal cut off to suggest intubation as difficult one.[13] In our study, majority of cases in OC group had lower value of IDS suggesting easy intubation when used in obese patients. Whereas more number of cases in OM group had higher value of IDS predicting difficult intubation with use of standard Macintosh laryngoscope.

Time taken for intubation was more in OM group 26.08±9.83 seconds as compared to OC group 15.96±7.24 seconds, and also statistically significant. This finding goes with previously published data. Yumul

et al compared the C-Mac video laryngoscope 22(+/-15) seconds with direct Macintosh laryngoscope 43seconds and concluded that time taken for tracheal intubation was significantly less with video laryngoscope.[14] Liu et al in their study on 360 patients compared the total intubation time between video laryngoscope and Macintosh laryngoscope, they also compared the timings of two laryngoscopes between junior anaesthesiologist (longer) and intubation when done by senior anaesthesiologist (shorter).[15]

MAP recorded at 1, 3 and 5min in our study. The difference was statistically significant only at 1 min, but insignificant at 3min and 5min.In previous study done by Aggarwal et al, mean arterial pressure was increased by12.94% with standard Macintosh laryngoscope while 14.01% in C-Mac video laryngoscope compared to the baseline values.[16] The difference may be due to the population observed while the parameters also depends on the technique of using laryngoscope by different anaesthesia personnel.

Heart rate and SpO2 both recorded at 1, 3 and 5min. However, that difference was statistically significant only at 5 min, but insignificant at 1min and 3min. The results were contradictory with the previous study done by Sarkilar et al in which the author observed that there was no hemodynamic instability when two laryngoscopes were compared. The dissimilarity is due to the difference in study population. In our study only obese patients were included who already have low functional residual capacity, decreased apnoea time while the study mentioned have excluded all the difficult intubation cases and parameters were observed for 2 minutes post intubation.[17]

Bronchospasm post intubation was seen with 4% of cases in OC group as compared to 16% cases in OM group. Leropoulos et al in their study on 50 morbidly obese patients observed bronchospasm in six obese patients and concluded that bronchospasm is not attributable to difficult intubation.[18] None of the cases in OC group had trauma. But 8% cases each in OM group had lip trauma and tongue trauma. Bakshi et al in a study concluded similar results where the complications related to the intubation procedure were higher in the direct laryngoscope group with more airway injuries. This could probably be related to the force which is inevitably applied to make the glottic view better.[19]

This study has few limitations. All the parameters were studied only in obese patients which itself is a predictor of difficult airway. Co morbidities of patients are not taken into account for this study.

CONCLUSION

We conclude that intubation difficulty score with high sensitivity and specificity is useful for assessing difficult intubation in both direct and indirect laryngoscope. Time taken for intubation in difficult airway is less in C-Mac videolaryngoscope as compared with standard Macintosh laryngoscope. Inter incisor gap and Wilson score are the two significant preoperative parameters which are related with intra operative parameter of difficult intubation in terms of IDS. With the development of new technologies, difficult airway algorithm and teaching practices, videolaryngoscope is a better choice with fewer hemodynamic changes and complication rates in difficult airway.

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