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A comparative study of head-elevated positions at 25° versus 45° for intubation in obese patients posted for elective surgery under general anesthesia

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ABSTRACT

Background: Obese patients generally present with an increased risk of difficult intubation. The head-elevated position has been shown to improve laryngeal view, reduce airway complications, and prolong safe apnea time during intubation as compared to the sniffing position. **Aims and Objectives:** The aim of this study is to compare the head-elevated positions at 25° versus 45° for intubation in obese patients, in terms of ease of intubation assessed by first-attempt intubation success rate and laryngeal exposure using Cormack–Lehane grading and to assess intubation time, use of intubation aides, changes in hemodynamic parameters, and hypoxia. **Materials and Methods:** In this randomized controlled trial, 100 consenting patients undergoing elective surgery requiring general anesthesia were selected who fulfilled the eligibility criteria and assigned to either of the two groups by block randomization: Group A – 25° or Group B – 45° head-elevated positions for intubation in a tertiary care hospital (February 2021–July 2022). **Results:** The 45° head-elevated position was found to provide a better laryngeal exposure, the mean time to intubate was lesser and the first attempt success rate was also higher. Further, 45° head-elevated position is better chosen as per anesthesiologist comfort, using Likert scale grading. **Conclusion:** This study concluded that 45° head-elevated position provides better ease of intubation in obese patients as compared to 25° head-elevation.

Key words: Head-elevated position; Obesity; Difficult intubation

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INTRODUCTION

Endotracheal intubation using direct laryngoscopy is the cornerstone of general anesthesia. Obese patients generally present with an increased risk of difficult airway, and they are also more prone to develop different systemic illnesses such as hypertension, obstructive sleep apnea, and restrictive and reactive lung disease which ultimately affect the perioperative morbidity and mortality.

Proper patient positioning is an important component of successful laryngoscopy and tracheal intubation. The head-elevated position has been shown better efficacy of preoxygenation, improvement of laryngeal view, reduce airway complications,[1] and prolong safe apnea time during intubation[2-4] contrary to the previous view of sniffing position. Conventional ramping position[5,6] defined as the horizontal alignment between the sternal notch and the external auditory meatus and commonly used in the airway management of obese patient.

Head elevated position can be achieved by ramping position, which may or may not be suitable as per the patient requirement as well as cumbersome to achieve in obese

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patient where the rapid airway management positioner is not available and becomes a subjective variable. In the head elevated position, the laryngeal structures move caudally both directly and indirectly by pulling down of the upper thoracic structure, and this phenomenon possibly causes improve alignment of the laryngeal axis and the line of vision during laryngoscopy.[7]

Here, we had chosen 25° and 45° head-elevated position for obese patient instead of upright (60° or more) because both positions are much more feasible and achievable both for patients' compliance and anesthesiologist comfort and none of the study until date had compared two fixed bed head elevated position in obese patient for intubation.

Aims and objectives

We aimed to compare the ease of intubation in the head elevation of 25° and 45° position in obese patients in Indian scenario (body mass index [BMI] ranging from 25 kg/m^2 to 35 kg/m^2).

Primary objective

1. Effect of ease of intubation in obese patients positioning at 25° versus 45° head-elevated position to be assessed by first attempt intubation success rate and laryngeal exposure which is determined by modified CL grading.

Secondary objective

1. To assess intubation time and the use of intubation aides during the intubation procedure
2. To assess adverse hemodynamic effects such as change in heart rate (HR), mean arterial pressure (MAP), systolic blood pressure (SBP), diastolic blood pressure (DBP), and oxygen saturation (SpO_2).

MATERIALS AND METHODS

This is a single-blind randomized controlled trial. This prospective study was conducted in 100 (n=100) consenting adult patients posted for elective surgery under general anesthesia in a tertiary care hospital from February 2021 to July 2022. After obtaining approval from Institutional Ethics Committee Ref No. MC/KOL/IEC/NON-SPON/949/01/2021 dated January 20, 2021, patients were screened and randomly assigned to either of the two groups: Group A – 25° or Group B – 45° head-elevated positions for endotracheal intubation (Figure 1).

Inclusion criteria

The following criteria were included in the study:

1. Patients between the age of 15 and 60 years
2. Scheduled for elective surgery undergoing general anesthesia with endotracheal intubation
3. BMI-25–35 kg/m^2
4. ASA-PS scoring II-III
5. Patients willing to participate in the study.

Exclusion criteria

The following criteria were excluded from the study:

1. Patient with BMI <25 kg/m^2 and more than 35 kg/m^2
2. Seizure disorder
3. Severe cardiovascular disorder
4. Psychiatric patients
5. Pregnancy
6. Bariatric surgery
7. Uncontrolled diabetes and hypertension
8. Patients with poor lung compliance
9. Previous bleeding disorder/coagulopathy
10. Neurological deficit
11. Patients suffering from renal and hepatic derangement and procedures associated with emergency surgery and rapid sequence intubation.

Patients were screened during pre-anesthetic check-up for eligibility of enrolment in the study. Eligible patients were offered the study-related information verbally and in writing. Willing patients were requested to give written informed consent for participation in the study, 100 patients were randomized into two groups as per number generated by open Epi random generator.

- Group A – 50 patients were positioned at 25° head elevated position.
- Group B – 50 patients were positioned at 45° head elevated position.

The number generated was kept with the sister-in-charge and was handed over to OT in-charge-anesthetist in the morning in an opaque sealed envelope when the patient was shifted to the OT. Standard fasting protocol was ensured and the patient was premedicated with tablet Ranitidine (150 mg) and tablet Alprazolam (0.25 mg) on night before surgery. The patients were cannulated with wide bore IV cannula and infusion with ringer lactate at 3–4 mL/kg was started in OT and oxygen was given through a nasal cannula with l0 L/min O_2 from the auxiliary port.

Preoxygenation was provided by at least 3–5 min of 100% O_2 via facemask ventilation and by ensuring a patent airway and effective mask seal during the entire period of pre-oxygenation and subsequent apneic oxygenation. A multichannel monitor was attached for monitoring of HR, non-invasive blood pressure, electrocardiography, pulse oximetry (SpO_2), respiratory rate, at baseline before induction and then 1, 3, 5, and 15 min after laryngoscopy and intubation and during surgery. Patient positioning done using electronic operator attached with OT table by elevating the head end of the table. Angle of elevation was

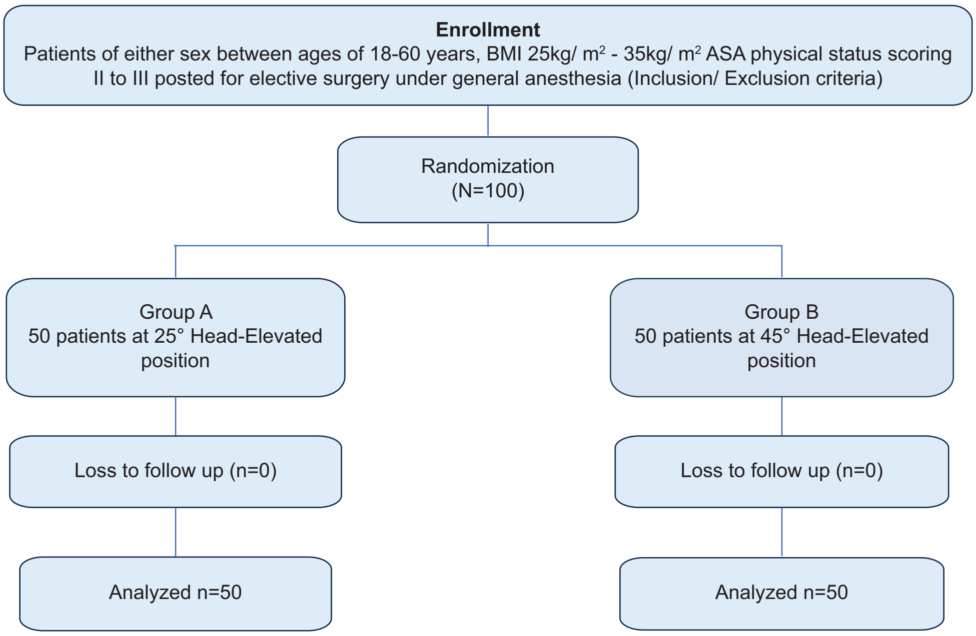

Figure 1: CONSORT diagram

Table 1: Demographic profile of both groups

Parameters	Group A (n=50)	Group B (n=50)	P-value
Mean age (Years)	42.64 (SD 8.88)	40.94 (SD 8.85)	0.17
Gender (%)			
Male	27 (54)	29 (58)	0.68
Female	23 (46)	21 (42)	
Weight (kg)	76.3 (SD 8.06)	78.42 (SD 8.00)	0.095
Mean BMI (kg/m^2)	29.29 (SD 2.38)	29.59 (SD 2.45)	0.266
ASA PS (%)			
II	34 (68)	41 (82)	0.106
III	16 (32)	9 (18)	

SD: Standard deviation, BMI: Body mass index

measured with respect to the upper half and lower half of table by goniometer. Choice of anesthetic type, agents, and monitoring was left to the anesthesiologist discretion following standard care guidelines and routine protocols. After checking for ability to achieve adequate mask ventilation, injection succinylcholine 1 mg/kg body weight was used to facilitate muscle relaxation. When neuromuscular block was completed, Macintosh laryngoscopy was done in both groups, and CL grading was assessed.

Grade I	Full view of glottis
Grade 2a	Partial view of glottis
Grade 2b	Only posterior extremity of glottis seen or only arytenoid cartilages
Grade 3	Only epiglottis seen
Grade 4	None of glottis seen

Then appropriate size endotracheal tube was inserted and the position confirmed by auscultation of bilateral chest and capnograph. Patients requiring more than three attempts and SpO_2 <90% were excluded from this study. These following parameters were observed number of attempts of intubation, intubation time (from laryngoscopy to appearance of square waveforms in capnography), anesthesiologist comfort by Likert scale (1-excellent, 2-good, 3-average, and 4-poor) use of ancillary equipment's and hemodynamic parameters (HR, MAP, and SpO_2) 1, 3, 5, 15 min after laryngoscopy and intubation during surgery.

Statistical analysis plan

In this study, a total of 100 participants were allocated into two groups. The results of the observation thus obtained in each group of the patient were tabulated, compiled, and statistically analyzed using the Statistical Package for the Social Sciences 26.0 version. If any $P<0.05$, it has been considered as statistically significant. Data were summarized as mean and standard deviation and compared across the groups using unpaired student's t-test. Categorical variables have been expressed as a number of patients and percentage of patients and compared across the groups using Pearson's Chi-square test.

Sample size

It was a study with power of 80% keeping 95% confidence interval, an alpha level of 0.05. Sample size calculated based on a small pilot study among 10 patients on each group. In the pilot study, P1 (first attempt intubation success rate in 25° head-elevated position)=75% and P2 (first attempt intubation success rate in 45° head-elevated position)=95%.

Hence, $P=(P1+P2)/2=85$, $Q=100-P=15$, and $(Z\alpha+Z\beta)^2=7.84$ (Constant).

Sample size in each group=2PQ(Zα+Zβ)2/(p1-p2)2=2×85×15×7.84/400=49.98=50.

So total sample size=100.

RESULTS

In this study, the demographic profiles such as mean age, gender, BMI, and ASA physical status between two groups were comparable (Table 1).

Airway assessment was done by Mallampati grading and Score II was more among both groups although this difference of grades among the groups was not statistically significant as P>0.05 at 0.05 level significance by the Chi-square test.

After proper induction and relaxation, laryngoscopy was done and C-L grading assessed in both groups. Table 2 shows that C-L Grade 2a was more in the group A while C-L Grade 1 more in Group B and this difference of grades among both groups was statistically significant as P<0.05 (0.027).

Intubation time for Group A (32.52±13.49 s) is more than Group B (25.14±9.98 s) which is statistically significant as the P<0.05 (P-0.0013) by independent t-test. The first attempt success rate for Group B was 82% while 60% in Group A was statistically significant as P<0.05(P-0.035) by Chi-square test (Figure 2). Use of external laryngeal maneuvers and use of intubation aids were less in both the groups and differences were not statistically significant as P>0.05 (Table 3).

Baseline hemodynamic parameters in both groups were comparable. There were no statistically significant differences in mean HR, mean SpO_2, mean SBP, and mean DBP between Group A and Group B of baseline, during intubation and 5 min after intubation as the P>0.05.

Likert scale was used to assess the ease of positioning. Excellent grades in Likert scale were 46% cases in Group A while 70% in Group B and poor grade in Likert scale was 2% cases in Group A while no case in Group B. The difference of grades among both the groups was statistically significant as P<0.05 (P=0.017) by Chi-square test (Figure 3).

DISCUSSION

This present study compared head-elevated positions at 25° (group A) versus 45° (group B) for intubation in obese patients posted for elective surgery under general anesthesia. The primary objective was ease of intubation to be assessed by first-attempt intubation success rate and laryngeal exposure which was determined by CL grading. The secondary objective was assessed by intubation time, use of intubation aides during intubation, and adverse hemodynamic alteration.

In our study, 100 consenting participants were randomly allocated into two groups, Group A (25°) and Group B

Table 2: Distribution of study subjects according to CL grading

CL grading	Group A		Group B		Total		Chi-square	
	n	%	n	%	N	%	Chi-square	P-value
1	17	34	29	58	45	45	9.156	0.027
2a	24	48	19	38	43	43		
2b	8	16	1	2	10	10		
3	1	2	1	2	2	2		
Total	50	100	50	100	100	100		

CL: Cormac Lehane grading

Table 3: Distribution of different intubation parameters

Parameters	Group A (n = 50)	Group B (n = 50)	Chi-square Value (df)	P-values
Intubation time	32.52 ± 13.49 s	25.14 ± 9.98 s		0.0013
No of attempts (%)				
1	30 (60)	41 (82)	6.704	0.035
2	18 (32)	09 (18)		
3	02 (04)	0		
Use of aides (7%)				
Yes	07 (14)	03 (06)	1.771	0.182
No	43 (86)	47 (94)		
Use of external laryngeal maneuvers (%)				
Yes	04 (08)	03 (06)	1.895	0.169
No	46 (92)	47 (94)		

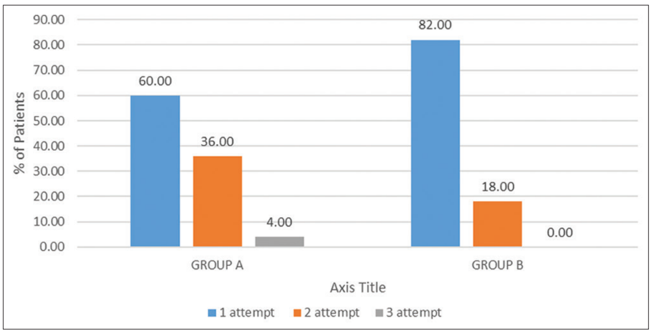

Figure 2: Distribution of the number of attempts for intubation among the groups (n=100)

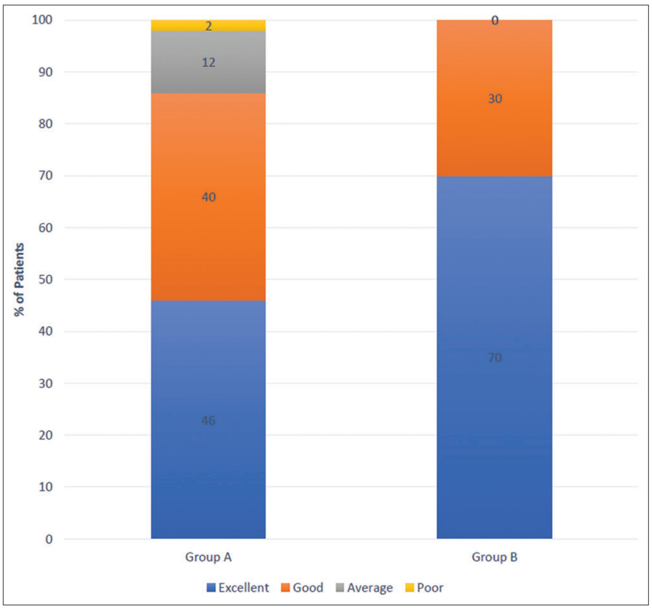

Figure 3: Distribution of Likert scale grading among the groups (n=100)

(45°). We found that the differences of mean age, height, weight, BMI, gender, ASA grading, and Mallampati score among the groups were not statistically significant.

The difference of Laryngoscopic CL grading between the two groups was found to be statistically significant (P=0.027). It was seen that 45° head elevated position provided a better laryngeal exposure than 25°. Probably 45° head elevated position provides better alignment of the oral, pharyngeal, and laryngeal axis which may explain the more first attempt success and anesthesiologist comfort for intubation.

In a randomized controlled trial among 40 patients, Lee et al., found that laryngeal view during laryngoscopy improves significantly in the 25° head-up position compared to the flat supine position due to the effect of gravity. The laryngeal structure moves caudally both directly and indirectly by pulling down the upper thoracic structure and this phenomenon possibly cause improve alignment of laryngeal axis and line of vision during laryngoscopy. They also suggested that there is an increase in the amount of horizontal force and concurrently a reduction in the amount of vertical force exerted during laryngoscopy, the change in force vector and torque coupled together with the effect in exposing laryngeal exposure in head elevated position.[8]

Similar in 2017, Turner et al., suggested from their study that head elevated positioning might be associated with improved glottic view.[9] In our study, there was also better laryngeal exposure in 45° of head elevation position. The mean time to intubate was found to be 32.52±13.49 s in Group A and 25.14±9.98 s in Group B. The difference was found to be statistically significant (P=-0.0013). Hence, intubation time in 45° patients is faster than 25° which is a quite significant not only statistically but also clinically as it ensures securing the airway faster, especially in obese patients.

Collins et al., demonstrated that head-elevated laryngoscopy position improves pulmonary compliance, better alignment of three airway axes, allows easier mask ventilation, and improves condition for tracheal intubation in obese patients.[10] The difference of mean number of attempts to intubate among the two groups was found to be statistically significant in our study. First attempt intubation success rate was 82% in Group B while 60% in Group A. Hence, intubation success rate among 45° head-elevated position was higher than 25° head-elevated position which was statistically significant (P=0.035).

In 2016, Reddy et al., conducted a study and found that there was improved the ease of intubation as judged by the need for fewer ancillary maneuvers and shorter time for intubation in 25° back up position compared to supine.[5] In our study, intubation aides were used only in seven cases of Group A while three cases in Group B which was found to be statistically insignificant (P>0.05). There was the use of external laryngeal maneuver in four cases of Group A while three cases in Group B which was found to be statistically insignificant (P>0.05).

In our study, there was also no statistically and clinically significant difference in hemodynamic alteration (HR, blood pressure, and SpO_2) in between the groups. Anesthesiologists comfort to perform intubation in the head-elevated position was expressed by Likert scale. In our study, grades of excellent in the Likert scale were 46% cases in Group A while 70% in Group B, and grades of poor in the Likert scale were 2% cases in Group A while no case in Group B. The difference of grades in both groups was statistically significant as P<0.05 and it is also clinically significant as the performer's comfort for laryngoscopy of utmost importance in airway maneuver. In our study, no patient required more than three attempts so none had to be excluded after randomization.

Limitations of the study

In spite of all possible sincere efforts, our study had some lacunae. The notable limitations of our study were the small sample size, single centered. Obese patients from emergency surgery and anticipated difficult airway were excluded from the study. Critically, ill patients at the critical care unit were also excluded due to COVID-19 pandemic situation.

CONCLUSION

45° head-elevated position provides better ease of intubation in obese patients which was assessed by more first attempt success rate and superior laryngeal exposure as compared to 25° head-elevated position. Hence, we hope to extend it in future practice to a larger population to explore its applications in the wider population.

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Authors' Contributions:
KM- Definition of intellectual content, literature survey, prepared the first draft of the manuscript, implementation of the study protocol, data collection, manuscript preparation, and submission of article; **FN-** Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **SC-** Design of study, statistical analysis, and interpretation; and **PB-** Review manuscript; analysis, and manuscript revision.

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