



Original Article

Comparing Ease of Intubation in Obese and Lean Patients Using the Intubation Difficulty Scale: A Prospective Observational Study

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ABSTRACT

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Received: 30-05-2026

Accepted: 27-06-2026

Available online: 08-07-2026

Background: Airway management is a cornerstone of anaesthetic practice, and obesity is a well-recognized risk factor for difficult tracheal intubation. However, most clinical airway assessments rely on subjective grading systems that may lack reproducibility. The Intubation Difficulty Scale (IDS) is a validated quantitative tool that objectively measures the complexity of tracheal intubation. This study aimed to compare the ease of intubation in obese and lean patients using the IDS and to evaluate associated airway characteristics and peri-intubation complications.

Methods: This prospective observational study included 150 adult patients undergoing elective surgery under general anaesthesia requiring tracheal intubation. Patients were divided into two groups: obese ($n = 75$; $\text{BMI} \geq 30 \text{ kg/m}^2$) and lean ($n = 75$; $\text{BMI} 18\text{--}24.9 \text{ kg/m}^2$). All intubations were performed by experienced anaesthesiologists using direct laryngoscopy. IDS scores were calculated using the seven standard parameters of the scale. Secondary outcomes included Mallampati classification, Cormack–Lehane grade, number of intubation attempts, time required for intubation, and peri-intubation complications. Data were analysed using the independent t-test and Chi-square test, with $p < 0.05$ considered statistically significant.

Results: The obese group demonstrated significantly higher mean IDS scores than the lean group (3.6 ± 1.5 vs. 1.5 ± 1.0 ; $p < 0.001$). Mallampati class III–IV was observed in 40% of obese patients compared with 20% of lean patients ($p = 0.01$). Similarly, Cormack–Lehane grade III–IV occurred in 40% of obese patients versus 20% of lean patients ($p = 0.01$). The mean intubation time was significantly longer in obese patients (35.1 ± 6.8 seconds vs. 25.3 ± 4.9 seconds; $p < 0.001$). Peri-intubation complications were also more frequent in the obese group (14.7% vs. 5.3%; $p = 0.04$).

Conclusion: Obesity is associated with significantly greater intubation difficulty, reflected by higher IDS scores, poorer laryngoscopic views, prolonged intubation time, and increased peri-intubation complications. These findings highlight the importance of meticulous preoperative airway assessment and preparedness with alternative airway management strategies in obese patients.

Keywords: Intubation Difficulty Scale; obesity; airway management; tracheal intubation; Mallampati classification; Cormack–Lehane grade.

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INTRODUCTION

Airway management is one of the most critical and potentially life-saving responsibilities of the anaesthesiologist. Failure to establish and maintain a patent airway can result in severe hypoxia, brain injury, or death within minutes [1]. Despite technological advancements in laryngoscopes, supraglottic airway devices, and fiberoptic systems, direct laryngoscopy with endotracheal intubation remains the most widely used method for securing the airway during general anaesthesia.

Obesity has emerged as a significant global health issue, with its prevalence tripling worldwide since 1975 according to the World Health Organization. In the perioperative setting, obesity presents multiple challenges to airway management. Excessive adipose tissue in the face, neck, and pharyngeal structures can obscure airway landmarks and impede optimal positioning. Furthermore, reduced functional residual capacity, increased oxygen consumption, and decreased pulmonary compliance in obese patients result in rapid desaturation during apnoea, leaving less margin for error during intubation attempts [2].

Traditionally, airway difficulty has been assessed preoperatively using predictors such as the Mallampati classification, thyromental distance, and inter-incisor gap [3]. However, these are qualitative assessments and may be prone to inter-observer variability. The Cormack–Lehane grading obtained during laryngoscopy provides some intraoperative assessment but does not fully quantify intubation complexity [4].

The Intubation Difficulty Scale (IDS), introduced by Adnet et al. in 1997, addresses this limitation by incorporating multiple objective parameters into a single score, ranging from 0 (easy intubation) to progressively higher values indicating increasing degrees of intubation difficulty. These parameters include the number of intubation attempts, number of operators, use of alternative techniques, Cormack–Lehane grade, need for increased lifting force, requirement for external laryngeal pressure, and vocal cord position [5]. By quantifying difficulty rather than simply categorizing intubations as "easy" or "difficult," the IDS provides a more comprehensive and reproducible assessment of airway management complexity.

Although the association between obesity and difficult tracheal intubation is well recognized, relatively few studies have employed the IDS to objectively quantify and compare intubation difficulty between obese and lean patients [2,5]. Therefore, the present prospective observational study was undertaken to compare the ease of intubation in obese and lean patients using the Intubation Difficulty Scale. In addition, the study aimed to evaluate associated airway characteristics, intubation time, and peri-intubation complications, thereby providing a comprehensive assessment of airway management challenges in obese individuals [5].

MATERIAL AND METHODS

This prospective observational study was conducted over a period of six months in the Department of Anaesthesiology at a tertiary care teaching hospital. Institutional Ethics Committee approval was obtained before commencement of the study, and written informed consent was obtained from all participants. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

A total of 150 adult patients scheduled for elective surgery under general anaesthesia requiring orotracheal intubation were enrolled. Patients were categorized into two groups according to body mass index (BMI): the obese group (BMI ≥ 30 kg/m²; n = 75) and the lean group (BMI 18.0-24.9 kg/m²; n = 75).

Inclusion criteria

Patients aged 18-65 years with American Society of Anesthesiologists (ASA) physical status I-III who were scheduled for elective surgery under general anaesthesia requiring endotracheal intubation were included. Patients with a BMI of 18.0-24.9 kg/m² were assigned to the lean group, whereas those with a BMI of ≥ 30 kg/m² were assigned to the obese group. Only patients who provided written informed consent were enrolled.

Exclusion criteria

Patients undergoing emergency surgery, those with known upper airway pathology (including tumours, trauma, or infection), previous tracheal or laryngeal surgery, pregnancy, anticipated difficult airway requiring advanced airway devices, or refusal to participate were excluded from the study.

Sample size: A pilot study involving 20 patients demonstrated a mean difference of 1.8 in Intubation Difficulty Scale (IDS) scores between obese and lean patients with a standard deviation of 2.0. Assuming a two-sided alpha error of 0.05 and a study power of 90%, the minimum required sample size was calculated as 70 patients per group. To compensate for possible dropouts, 75 patients were recruited in each group, resulting in a total sample size of 150 patients.

Methodology

Preoperative assessment: All patients underwent a comprehensive pre-anaesthetic evaluation. Demographic characteristics, BMI, ASA physical status, and associated comorbidities were recorded. Airway assessment included

Mallampati classification, thyromental distance, inter-incisor distance, neck circumference, and assessment of neck mobility. Height and weight were measured using standardized methods, and BMI was calculated as weight in kilograms divided by the square of height in metres.

Anaesthetic technique: Routine monitoring, including electrocardiography, non-invasive blood pressure, pulse oximetry, and capnography, was instituted before induction of anaesthesia. Patients were preoxygenated with 100% oxygen for three minutes. Anaesthesia was induced with intravenous fentanyl (2 µg/kg), propofol (2-2.5 mg/kg), and rocuronium (0.6 mg/kg). Anaesthesia was maintained using sevoflurane in an oxygen-air mixture according to institutional protocol.

Intubation procedure: All tracheal intubations were performed using a Macintosh laryngoscope blade (size 3 or 4) by anaesthesiologists with at least three years of postgraduate experience. Patients were positioned in the sniffing position, and external laryngeal manipulation was applied whenever necessary. Standardized endotracheal tube sizes were used (7.0-7.5 mm internal diameter for females and 8.0-8.5 mm for males).

Intubation Difficulty Scale assessment: The Intubation Difficulty Scale (IDS) described by Adnet et al. was used to objectively assess intubation difficulty. The IDS was calculated by summing seven variables:

- N1: Number of attempts – 1
- N2: Number of operators – 1
- N3: Alternative intubation techniques used (0 if none)
- N4: Cormack–Lehane grade – 1
- N5: Need for increased lifting force (0 if not required, 1 if required)
- N6: Need for external laryngeal pressure (0 if not required, 1 if required)
- N7: Position of vocal cords (0 if abducted, 1 if adducted)

An IDS of 0 indicates easy intubation, 1–5 moderate difficulty, and >5 major difficulty.

Additional data collection

- Time to intubation (seconds) from laryngoscope insertion to confirmed capnography
- Number of intubation attempts
- Peri-intubation complications (oxygen desaturation <90%, mucosal injury, dental trauma)

Outcome measures:

The primary outcome was the comparison of IDS scores between obese and lean patients. Secondary outcomes included Mallampati classification, Cormack-Lehane laryngoscopic grade, number of intubation attempts, time to successful intubation (defined as the interval from insertion of the laryngoscope until confirmation by continuous capnography), and peri-intubation complications including oxygen desaturation (SpO₂ <90%), mucosal injury, and dental trauma.

Statistical analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation and compared using the independent Student's *t*-test. Categorical variables were presented as frequencies and percentages and analysed using the chi-square test or Fisher's exact test, as appropriate. A two-tailed *p*-value of <0.05 was considered statistically significant.

RESULTS

A total of 150 patients were enrolled and completed the study, with 75 patients each in the lean (BMI 18.0-24.9 kg/m²) and obese (BMI ≥30 kg/m²) groups. No patient was excluded after induction of anaesthesia, and there were no protocol deviations.

Baseline characteristics: The baseline demographic and airway characteristics are presented in **Table 1**. The mean age was comparable between the lean and obese groups (40.1 ± 10.2 vs. 42.0 ± 9.0 years, *p* = 0.21). As expected, BMI was significantly higher in the obese group than in the lean group (33.0 ± 2.5 vs. 22.1 ± 1.5 kg/m², *p* < 0.001). There were no statistically significant differences in sex distribution or ASA physical status between the groups. However, obese patients demonstrated significantly higher proportions of Mallampati class III-IV (40% vs. 20%, *p* = 0.01) and Cormack-Lehane grade III-IV (40% vs. 20%, *p* = 0.01).

Table 1. Baseline demographic and airway characteristics

Parameter	Lean (n = 75)	Obese (n = 75)	<i>p</i> value
Age (years)	40.1 ± 10.2	42.0 ± 9.0	0.21
Male/Female (%)	52/48	55/45	0.72
BMI (kg/m ²)	22.1 ± 1.5	33.0 ± 2.5	<0.001
ASA I/II/III (%)	48/40/12	48/40/12	0.88
Mallampati class III-IV, n (%)	15 (20.0)	30 (40.0)	0.01

Cormack-Lehane grade III-IV, n (%)	15 (20.0)	30 (40.0)	0.01
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Intubation Difficulty Scale: The comparison of Intubation Difficulty Scale (IDS) scores between the two groups is presented in **Table 2** and illustrated in **Figure 1**. The mean IDS score was significantly higher in obese patients than in lean patients (3.6 ± 1.5 vs. 1.5 ± 1.0 , $p < 0.001$). Easy intubation (IDS = 0) was more common among lean patients (22.7%) than obese patients (6.7%). Conversely, major intubation difficulty (IDS >5) occurred in 14.0% of obese patients compared with only 2.7% of lean patients.

Table 2. Distribution of Intubation Difficulty Scale (IDS) scores

IDS category	Lean (n = 75), n (%)	Obese (n = 75), n (%)
0 (Easy)	17 (22.7)	5 (6.7)
1-2 (Mild difficulty)	34 (45.3)	20 (26.7)
3-5 (Moderate difficulty)	22 (29.3)	39 (52.0)
>5 (Major difficulty)	2 (2.7)	11 (14.7)

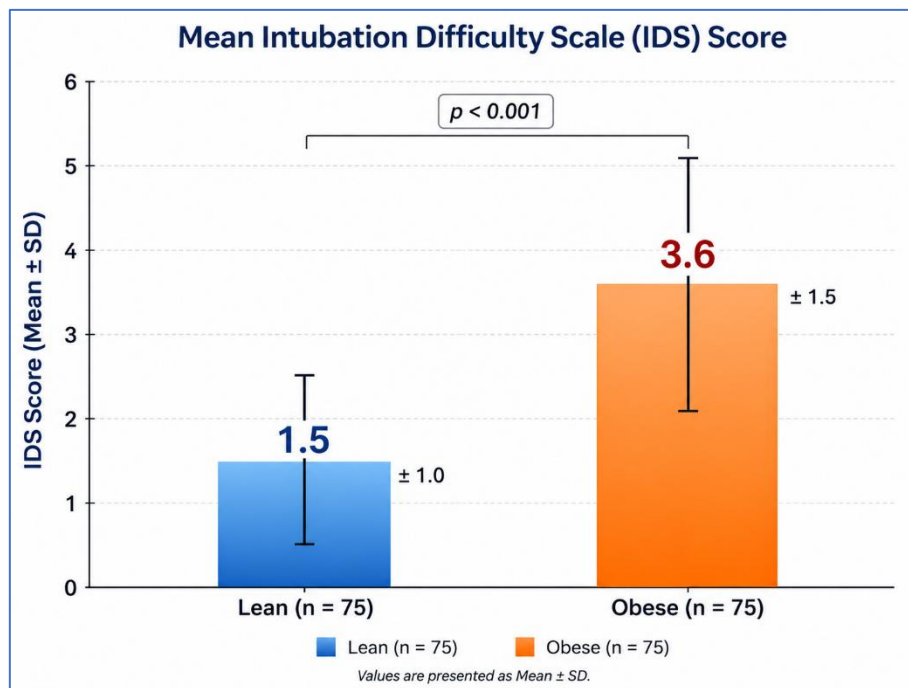


Figure 1. Comparison of mean Intubation Difficulty Scale (IDS) scores between lean and obese patients.

Mallampati classification: The distribution of Mallampati classes is shown in **Figure 2** and summarized in **Table 3**. Lean patients had a higher proportion of Mallampati class I (38.7%) and class II (41.3%), whereas obese patients more frequently demonstrated Mallampati class III (28.0%) and class IV (12.0%).

Table 3. Mallampati classification

Mallampati class	Lean (n = 75), n (%)	Obese (n = 75), n (%)
Class I	29 (38.7)	16 (21.3)
Class II	31 (41.3)	29 (38.7)
Class III	12 (16.0)	21 (28.0)
Class IV	3 (4.0)	9 (12.0)

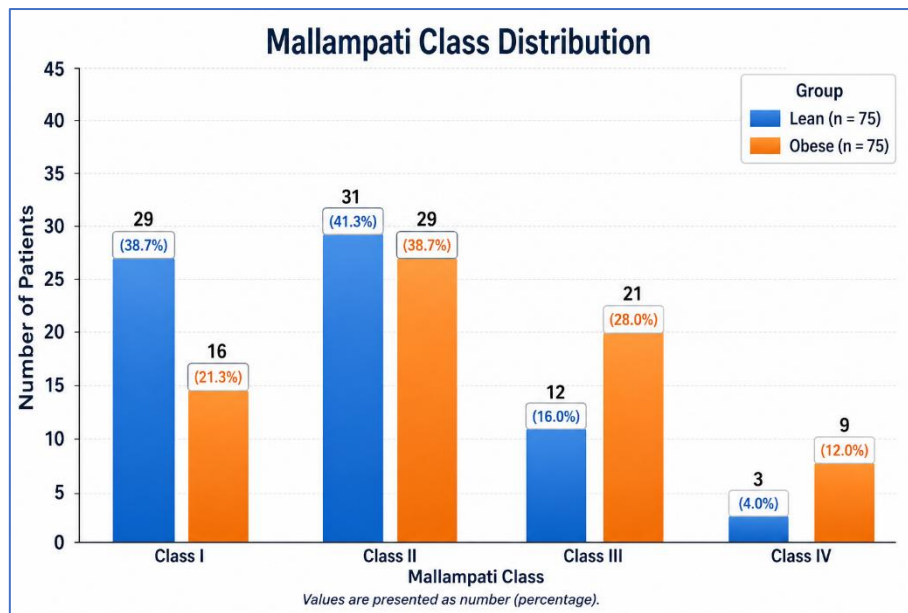


Figure 2. Distribution of Mallampati classification in lean and obese patients.

Cormack-Lehane grading: Cormack-Lehane grading during direct laryngoscopy is illustrated in Figure 3 and summarized in Table 4. Grade I laryngoscopic view was more frequently observed in lean patients (50.7%) than obese patients (26.7%), whereas grade III and IV views were considerably more common in obese patients (38.7%) than in lean patients (20.0%).

Table 4. Cormack-Lehane grading during laryngoscopy

Grade	Lean (n = 75), n (%)	Obese (n = 75), n (%)
Grade I	38 (50.7)	20 (26.7)
Grade II	22 (29.3)	26 (34.7)
Grade III	11 (14.7)	18 (24.0)
Grade IV	4 (5.3)	11 (14.7)

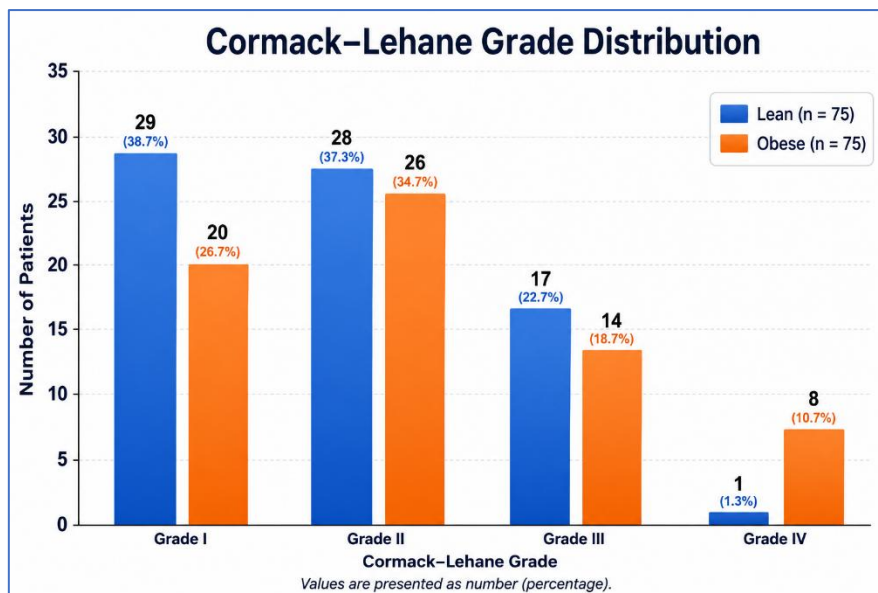


Figure 3. Distribution of Cormack-Lehane grades during direct laryngoscopy.

Intubation time and number of attempts: The comparison of intubation time between the two groups is illustrated in Figure 4 and summarized in Table 5. The mean time required for successful tracheal intubation was significantly longer in obese patients than in lean patients (35.1 ± 6.8 seconds vs. 25.3 ± 4.9 seconds, $p < 0.001$). Multiple intubation attempts (≥ 2) were required significantly more frequently in obese patients than in lean patients (25.3% vs. 10.7%, $p = 0.02$).

Table 5. Intubation time and number of attempts

Parameter	Lean (n = 75)	Obese (n = 75)	p value
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Intubation time (seconds)	25.3 ± 4.9	35.1 ± 6.8	<0.001
Single attempt, n (%)	67 (89.3)	56 (74.7)	0.02
≥2 attempts, n (%)	8 (10.7)	19 (25.3)	0.02

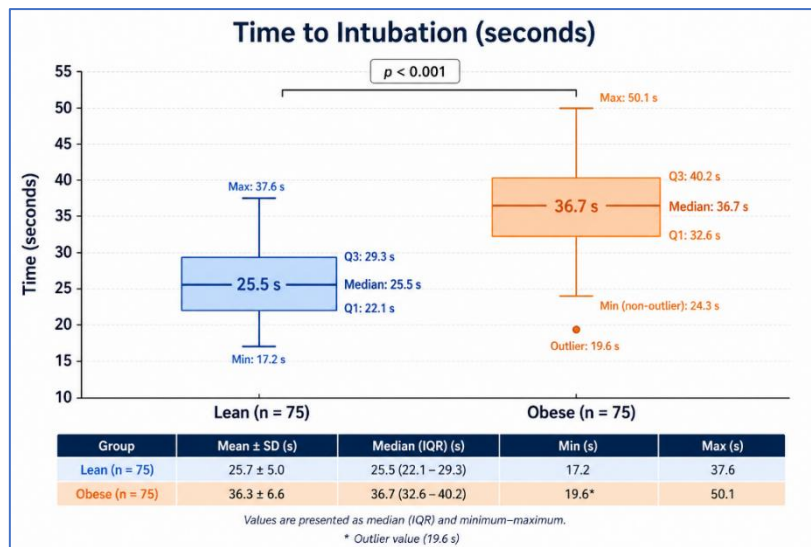


Figure 4. Comparison of mean intubation time between lean and obese patients.

Peri-intubation complications: Peri-intubation complications are presented in Table 6. The overall complication rate was significantly higher in obese patients than in lean patients (14.7% vs. 5.3%, $p = 0.04$). Mucosal trauma was the most frequently observed complication, followed by transient oxygen desaturation ($SpO_2 < 90\%$). Dental injury occurred in one patient in the obese group. No patient required rescue airway techniques such as fiberoptic bronchoscopy or surgical airway access.

Table 6. Peri-intubation complications

Complication	Lean (n = 75), n (%)	Obese (n = 75), n (%)	p value
Oxygen desaturation ($SpO_2 < 90\%$)	1 (1.3)	4 (5.3)	0.17
Mucosal trauma	3 (4.0)	6 (8.0)	0.31
Dental injury	0	1 (1.3)	0.32
Total complications	4 (5.3)	11 (14.7)	0.04

DISCUSSION

The present prospective observational study demonstrated that obese patients experienced significantly greater difficulty during direct laryngoscopic tracheal intubation than lean patients, as evidenced by higher Intubation Difficulty Scale (IDS) scores, poorer preoperative and intraoperative airway assessment grades, longer intubation times, increased requirement for multiple intubation attempts, and a higher incidence of peri-intubation complications. These findings reinforce the established association between obesity and increased airway management complexity and highlight the utility of the IDS as an objective tool for quantifying intubation difficulty.

Our study demonstrated a significantly higher mean IDS score in obese patients (3.6 ± 1.5) compared with lean patients (1.5 ± 1.0). Moreover, major intubation difficulty ($IDS > 5$) was observed in 14% of obese patients compared with only 2.7% of lean patients. These findings are consistent with the original work by Adnet et al., who developed the IDS and demonstrated that the scale provides a reliable and reproducible quantitative assessment of intubation difficulty by integrating multiple peri-intubation variables into a single objective score [10].

The higher incidence of difficult laryngoscopy observed in the obese group in our study is comparable to the findings of Juvin et al., who reported a significantly greater incidence of difficult tracheal intubation in obese patients than in non-obese individuals, despite standardized anaesthetic techniques. Their study concluded that obesity is associated with more frequent difficult laryngoscopy and intubation, although successful airway management can generally be achieved with appropriate preparation [11].

Similarly, Ezri et al. demonstrated that obesity alone is not the sole determinant of difficult intubation; rather, increased neck circumference is a stronger predictor of airway difficulty. Patients with larger neck circumferences had significantly higher rates of difficult laryngoscopy irrespective of BMI, emphasizing the importance of incorporating anatomical

measurements into routine preoperative airway assessment [12]. Although neck circumference was documented in our study, it was not analysed independently, representing a potential area for future investigation.

Our findings of significantly higher Mallampati class III-IV and Cormack-Lehane grade III-IV among obese patients are also consistent with previous literature. Kim et al. reported that the ratio of neck circumference to thyromental distance predicted difficult intubation more accurately than BMI alone and demonstrated a strong correlation with poor laryngoscopic views [13]. Likewise, a recent systematic review by Narra et al. concluded that obesity itself is an imperfect predictor of difficult intubation and that combining BMI with airway assessment parameters such as Mallampati grade, neck circumference, and thyromental distance substantially improves predictive accuracy [14]. These observations support our findings, where obese patients exhibited significantly poorer airway assessment scores than lean individuals.

The prolonged intubation time observed in obese patients (35.1 ± 6.8 seconds versus 25.3 ± 4.9 seconds) is clinically important. Reduced functional residual capacity, increased oxygen consumption, and decreased pulmonary compliance in obese individuals shorten the duration of safe apnoea, making prolonged intubation attempts potentially hazardous. De Jong et al., in a large multicentre observational study, similarly demonstrated that obese patients experience higher rates of difficult intubation and require more advanced airway techniques than non-obese patients, particularly when conventional direct laryngoscopy is employed [15].

Our study also demonstrated a significantly higher requirement for multiple intubation attempts among obese patients (25.3% versus 10.7%). Multiple laryngoscopy attempts are associated with increased airway trauma, hypoxaemia, haemodynamic instability, and aspiration risk. The increased frequency of multiple attempts observed in our study is therefore consistent with the higher IDS scores and poorer glottic visualization recorded in obese patients.

Peri-intubation complications were also significantly more frequent in obese patients. Although most complications consisted of minor mucosal trauma and transient oxygen desaturation, the overall complication rate was nearly three times higher than that observed in lean patients. Similar findings have been reported in previous studies evaluating airway management in obese patients, where increased airway manipulation and repeated intubation attempts contributed to higher complication rates [15].

Several anatomical and physiological factors explain these observations. Excess adipose tissue surrounding the upper airway narrows the pharyngeal lumen, increases airway collapsibility, and reduces visualization of the glottis during direct laryngoscopy. Fat deposition over the cervical spine and posterior neck limits neck extension and reduces atlanto-occipital mobility, while increased chest wall mass decreases pulmonary compliance and functional residual capacity. Together, these factors contribute to more difficult laryngoscopy, rapid oxygen desaturation, and increased intubation complexity [14,15].

The findings of the present study have important clinical implications. Identification of obese patients as being at increased risk for difficult intubation should prompt meticulous preoperative airway assessment and preparation. Availability of adjuncts such as bougies, videolaryngoscopes, supraglottic airway devices, and a well-equipped difficult airway cart should be ensured before induction of anaesthesia. Previous studies have demonstrated that positioning obese patients in the ramped position, aligning the external auditory meatus with the sternal notch, improves laryngoscopic view and facilitates tracheal intubation [16]. Furthermore, early use of videolaryngoscopy has been shown to improve first-pass success and reduce airway-related complications in obese patients and should be considered when difficult airway is anticipated [15,16]. The strengths of the present study include its prospective design, standardized anaesthetic protocol, uniform intubation technique performed by experienced anaesthesiologists, and use of the validated IDS, which provides a reproducible quantitative assessment of intubation difficulty rather than relying solely on subjective grading systems.

However, certain limitations should be acknowledged. First, the study was conducted at a single centre, which may limit the generalizability of the findings. Second, all intubations were performed by experienced anaesthesiologists, and the degree of difficulty may differ among less experienced operators. Third, videolaryngoscopy was not evaluated; therefore, the results primarily reflect direct laryngoscopy. Finally, although neck circumference was recorded during preoperative assessment, its independent association with IDS was not analysed.

Future multicentre studies including larger populations should evaluate the impact of videolaryngoscopy on IDS scores in obese patients and develop predictive models incorporating BMI, neck circumference, thyromental distance, and ultrasonographic airway measurements. Such studies may facilitate more accurate preoperative identification of patients at risk of difficult airway management and improve perioperative safety.

CONCLUSION

Obese patients experience significantly greater difficulty during tracheal intubation than lean patients, as demonstrated by higher Intubation Difficulty Scale (IDS) scores, poorer laryngoscopic views, longer intubation times, increased need for multiple intubation attempts, and a higher incidence of peri-intubation complications. These findings emphasize the

importance of thorough preoperative airway assessment, appropriate patient positioning, and preparedness with advanced airway adjuncts when managing obese patients. The IDS provides an objective and reliable measure of intubation difficulty and may aid in improving airway management strategies. Further multicentre studies are needed to validate these findings and optimize airway management protocols in obese patients.

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