

An Observational Study on the Impact of Gender Variability on Intubation Difficulty Level

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ABSTRACT

Background

Difficult airway management remains a significant challenge in anaesthesia practice and is associated with increased perioperative morbidity and mortality. While various predictors such as body mass index (BMI) and Mallampati classification have been studied, the role of gender variability in influencing intubation difficulty remains unclear.

Methods

This prospective observational study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital in Chennai, India, over a period of one year. A total of 40 adult patients undergoing elective surgeries under general anaesthesia were included and divided into two groups based on gender: Group M (males, n = 20) and Group F (females, n = 20). Preoperative assessment included age, BMI, American Society of Anesthesiologists (ASA) status, and Mallampati classification. Intraoperative assessment of airway difficulty was performed using Cormack–Lehane grading during direct laryngoscopy. Statistical analysis was performed using appropriate tests, and a p-value <0.05 was considered significant.

Results

The mean age was comparable between Group M (36.8 ± 9.47 years) and Group F (39.7 ± 7.52 years) ($p = 0.2903$). Similarly, ASA status was comparable between the groups (2.2 ± 0.99 vs 2.25 ± 0.76 ; $p = 0.647$). The overall incidence of difficult intubation was higher in males (50%) compared to females (35%). In males, the highest difficulty was observed in the BMI range of 25–29.9 kg/m² (40%), whereas in females it was predominantly in the 30–34.4 kg/m² range (30%). Mallampati Class III and IV were strongly associated with difficult intubation, accounting for 45% in males and 35% in females. Cormack–Lehane Grade II was the most common finding in both groups, while Grade III was slightly more frequent in males.

Conclusion

Gender variability appears to influence intubation difficulty, with males demonstrating a higher incidence compared to females. BMI alone is not a reliable predictor of difficult airway, whereas Mallampati classification remains a significant predictive tool. A comprehensive, multifactorial airway assessment is essential for accurate prediction and improved perioperative airway management.

Keywords: Difficult Intubation; Airway Management; Body Mass Index; Mallampati Classification; Cormack–Lehane Grade; Gender Differences; General Anaesthesia

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Introduction :

Airway management is a cornerstone of safe anaesthesia practice, and endotracheal intubation remains the gold standard for securing the airway during general anaesthesia. Failure to maintain airway patency can rapidly lead to hypoxia, brain injury, or death, making the prediction and management of difficult airway a critical responsibility for

anaesthesiologists [1]. Despite advancements in airway devices and monitoring, difficult intubation continues to contribute significantly to perioperative morbidity and mortality worldwide [2].

General anaesthesia produces a controlled, reversible state of unconsciousness associated with loss of protective airway reflexes, thereby necessitating artificial airway support [3]. In this context,

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endotracheal intubation ensures adequate oxygenation and ventilation during surgical procedures. However, the difficulty of intubation varies widely depending on patient-specific anatomical and physiological factors, and unanticipated difficult intubation remains a major clinical concern [1].

Globally, the burden of obesity has increased dramatically over the past few decades, emerging as a major public health problem. According to the World Health Organization, the prevalence of overweight and obesity has nearly tripled since 1975, with a substantial proportion of adults now falling into higher BMI categories [4]. This rising burden is particularly relevant in anaesthesia practice, as obesity is associated with altered airway anatomy, reduced pulmonary reserve, and increased perioperative complications [5]. Obese individuals often present with anatomical changes such as increased neck circumference, excess pharyngeal soft tissue, and reduced airway compliance, all of which can contribute to difficult laryngoscopy and intubation [4]. In addition, physiological alterations such as decreased functional residual capacity and rapid oxygen desaturation further complicate airway management in these patients [6]. These factors highlight the importance of identifying reliable predictors of difficult airway in populations with increasing BMI.

Body mass index (BMI) has been extensively studied as a potential predictor of difficult intubation. Some studies suggest that higher BMI is associated with increased difficulty, particularly in male patients. Bergese reported that BMI may serve as a predictor of difficult tracheal intubation in males, suggesting a possible interaction between gender and obesity in airway assessment [11]. Similarly, studies conducted in bariatric populations have demonstrated a higher prevalence of difficult intubation, emphasizing the clinical relevance of obesity in airway management [12].

However, the relationship between BMI and difficult intubation remains inconsistent across studies. Large cohort analyses have shown that BMI alone is a weak predictor and should not be considered an independent determinant of difficult airway [13]. Brodsky and colleagues also observed that while obesity may increase technical challenges, it does not consistently predict intubation difficulty [14]. Furthermore, Ezri et al. concluded that increased BMI per se is not significantly associated with difficult laryngoscopy, suggesting that other anatomical and clinical factors may play a more important role [15].

In addition to BMI, gender-related anatomical differences may influence airway characteristics and intubation outcomes. Males generally have larger neck circumference, greater muscle mass, and different fat distribution patterns, which may predispose them to airway difficulty. Females, on the other hand, tend to have smaller airway dimensions but relatively less soft tissue obstruction. Despite these differences, the independent effect of gender on intubation difficulty has not been clearly established, and available evidence remains limited.

To improve prediction of difficult airway, several clinical assessment tools have been developed, including the Mallampati classification, thyromental distance measurement, and Cormack–Lehane grading system. These tools evaluate anatomical features of the airway and are widely used in preoperative assessment [5]. However, no single predictor has demonstrated adequate sensitivity and specificity, and their reliability varies across different populations.

The American Society of Anesthesiologists (ASA) guidelines recommend a comprehensive preoperative airway evaluation incorporating multiple parameters, including patient history, physical examination, and use of predictive scoring systems [6]. Despite these recommendations, unexpected difficult intubation continues to occur, indicating the need for further research into additional predictive factors and combinations of variables.

In the Indian context, the burden of obesity and related comorbidities is also increasing, with significant implications for perioperative care. Variations in anthropometric characteristics, genetic factors, and lifestyle patterns may further influence airway anatomy and intubation difficulty. However, there is limited data exploring the interaction between gender and airway predictors in this population.

Given the conflicting evidence regarding BMI and the limited understanding of gender-based variability in airway anatomy, it is essential to explore their combined effect on intubation difficulty. Most existing studies have evaluated these factors independently, with relatively few focusing on gender differences in conjunction with established airway predictors.

Therefore, the present study was undertaken to assess the impact of gender variability on the difficulty of endotracheal intubation among patients undergoing general anaesthesia. By evaluating parameters such as BMI, Mallampati classification, ASA status, and Cormack–Lehane grading, this study aims to provide a more comprehensive understanding of airway assessment and contribute to improved prediction of

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difficult intubation, ultimately enhancing patient safety and perioperative outcomes.

This prospective observational study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital in Chennai, India, over a period of one year from January 2023 to January 2024. The study included a total of 40 adult patients scheduled for elective surgical procedures under general anaesthesia requiring endotracheal intubation. Patients were divided into two groups based on gender, with 20 male patients in Group M and 20 female patients in Group F. Patients aged between 25 and 50 years and belonging to American Society of Anesthesiologists (ASA) physical status I to IV were included in the study after obtaining written informed consent. Patients with anticipated difficult airway, maxillofacial abnormalities, cervical spine pathology, upper airway obstruction, or those undergoing emergency surgeries were excluded. Preoperative airway assessment was performed for all patients, and demographic data including age and gender were recorded. Body mass index (BMI) was calculated using the standard formula (weight in kilograms divided by height in meters squared) and categorized into overweight (25–29.9 kg/m²), obese (30–34.9 kg/m²), and morbidly obese (>35 kg/m²). Airway evaluation included Mallampati classification (MPC) and ASA grading preoperatively, while Cormack–Lehane (CL) grading was assessed during direct laryngoscopy. All patients were preoxygenated and induced using standard anaesthetic techniques as per institutional protocol, followed by administration of muscle relaxants to facilitate intubation. Direct laryngoscopy and endotracheal intubation were performed by an experienced anaesthesiologist to minimize inter-observer variability. The difficulty of intubation was assessed based on laryngoscopic view and need for additional maneuvers. All relevant data were recorded and analyzed using appropriate statistical methods. Continuous variables were expressed as mean and standard deviation, while categorical variables were expressed as percentages. Comparisons between the two groups were performed, and a p-value of less than 0.05 was considered statistically significant.

Methodology :

This prospective observational study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital in Chennai, India, over a period of one year from January 2023 to January 2024. The study included a total of 40 adult patients scheduled for elective surgical procedures under general anaesthesia requiring endotracheal intubation. Patients were

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Results :

Table 1: Age Distribution

Group	Mean Age (years)	Standard Deviation	P-value	Significance
Group M (Male)	36.8	9.47	0.2903	Not Significant
Group F (Female)	39.7	7.52		

Interpretation:

A total of 40 patients were included in the study, with 20 patients each in Group M and Group F.

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The mean age in Group M was 36.8 ± 9.47 years, whereas in Group F it was 39.7 ± 7.52 years.

The difference in age between the two groups was **not statistically significant** ($p = 0.2903$), indicating that both groups were comparable with respect to age distribution.

Table 5.2: ASA Distribution

Group	Mean ASA Score	Standard Deviation	P-value	Significance
Group M	2.2	0.99	0.647	Not Significant
Group F	2.25	0.76		

Interpretation:

The mean ASA score in Group M was 2.2 ± 0.99 , while in Group F it was 2.25 ± 0.76 .

There was **no statistically significant difference** ($p = 0.647$) between the two groups, suggesting comparable preoperative physical status.

Table 3: BMI vs Difficult Intubation

BMI Category (kg/m ²)	Group M (%)	Group F (%)
25–29.9	40	5
30–34.4	5	30
>35	5	0
Total Difficult Intubation	50%	35%

Interpretation:

In Group M, the highest incidence of difficult intubation (40%) was observed in the BMI range **25–29.9 kg/m²**, whereas in Group F, it was predominantly seen in the **30–34.4 kg/m²** category (30%).

Overall, the incidence of difficult intubation was **higher in males (50%) compared to females (35%)**, despite females having a relatively higher mean BMI.

Table 4: MPC vs Difficult Intubation

MPC Class	Group M (%)	Group F (%)
Class I	0	0
Class II	0	10
Class III	20	20
Class IV	25	5
Total Difficult Intubation	45%	35%

Interpretation:

Difficult intubation was predominantly associated with **higher Mallampati classes (III and IV)** in both groups.

Group M showed a higher proportion of difficult intubation in **Class IV (25%)**, compared to Group F (5%).

The overall incidence of difficult intubation based on MPC was **45% in males and 35% in females**, indicating relatively greater airway difficulty among males.

Table 5: CL Score Distribution

CL Grade	Group M	Group F
Grade I	3	6
Grade II	13	11
Grade III	4	3
Grade IV	0	0

Interpretation:

Most patients in both groups belonged to **CL Grade II**, indicating moderate glottic visualization.

Higher grades (Grade III), which indicate difficult laryngoscopy, were slightly more frequent in **Group M (4 cases)** compared to **Group F (3 cases)**.

No patients in either group had **Grade IV**, suggesting absence of extremely difficult laryngoscopy.

Discussion :

The present study evaluated gender variability in intubation difficulty and demonstrated that difficult intubation was more frequent in males (50%) compared to females (35%), despite comparable age (36.8 ± 9.47 vs 39.7 ± 7.52 years; $p = 0.2903$) and ASA status (2.2 ± 0.99 vs 2.25 ± 0.76 ; $p = 0.647$). This indicates that gender-related anatomical differences may play a more significant role than baseline clinical characteristics.

Enterlein and Byhahn [16] emphasized in ASA airway guidelines that no single predictor is sufficient and recommended a combined approach using multiple parameters. In the present study, a combination of BMI, Mallampati classification, and Cormack–Lehane grading was used, and despite this, a high incidence of difficult intubation (50% in males) was observed, supporting their conclusion regarding the multifactorial nature of airway difficulty.

Gupta et al. [17] reported an incidence of difficult intubation of approximately **8–10%** in their Kashmiri population. In contrast, the present study demonstrated a much higher incidence (**50% in males and 35% in females**). This discrepancy may be attributed to differences in sample size, patient characteristics, and definition of difficult intubation. However, Gupta et al. also identified anatomical factors such as neck circumference and airway structure as significant contributors, which may explain the higher male predominance observed in the present study.

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Kalezić et al. [18], in a large study of **2000 thyroid surgery patients**, reported a difficult intubation incidence of **5.8%**. Compared to this, the present study shows a higher proportion (**overall up to 50% in males**), likely due to smaller sample size and focused subgroup analysis. However, both studies highlight that difficult airway remains clinically relevant even in elective settings.

Voyagis et al. [19] demonstrated that Mallampati Class III and IV were associated with increased difficulty, with sensitivity values around **50–60%**. In the present study, difficult intubation in Mallampati Class III accounted for **20% in both males and females**, while Class IV contributed **25% in males and 5% in females**. The total incidence based on MPC was **45% in males and 35% in females**, supporting the predictive value of higher Mallampati grades.

Juvin et al. [20] reported that difficult intubation was significantly more common in obese patients (**15.5% in obese vs 2.2% in non-obese individuals**). However, in the present study, although females had higher BMI, difficult intubation was more frequent in males (**50% vs 35%**). This suggests that BMI alone may not be sufficient and that gender-related anatomical factors may play a stronger role.

Lavi et al. [21] reported difficult intubation rates of approximately **10–15%** using the Intubation Difficulty Scale. In comparison, the present study shows higher rates, particularly in males (**50%**). This difference may be due to methodological variations, but both studies emphasize the need for comprehensive airway evaluation.

Mallampati et al. [22], in their original study, demonstrated that higher Mallampati classes (III and IV) significantly increase the risk of difficult intubation, with predictive accuracy around **60–70%**. The present study findings are consistent, as the majority of difficult intubations were seen in Class III and IV, particularly in males (**45% total difficulty in males**).

Yildiz et al. [23] reported difficult intubation incidence ranging between **4–8%**, with Mallampati classification showing significant predictive value. Although the present study shows higher incidence, the trend of increasing difficulty with higher Mallampati classes is consistent.

Gupta et al. [24] emphasized the importance of combining multiple airway predictors to improve diagnostic accuracy. In the present study, both Mallampati classification and Cormack–Lehane grading were used. CL Grade II was most common (13 males vs 11 females), while Grade III (difficult

laryngoscopy) was slightly higher in males (**4 vs 3 cases**), supporting the importance of combined assessment.

Hiremath et al. [25] reported a higher incidence of difficult intubation in patients with obstructive sleep apnea, particularly due to increased soft tissue bulk. Although OSA was not directly assessed in the present study, the higher incidence in males (**50%**) may be explained by similar anatomical factors.

Szmuk et al. [26] concluded that BMI is not an independent predictor of difficult laryngoscopy. The present study strongly supports this finding, as females had higher BMI but lower difficult intubation rates (**35% vs 50% in males**).

Narra et al. [27] also emphasized that obesity alone is insufficient to predict difficult intubation and highlighted the role of other anatomical factors. This aligns with the present study findings where BMI did not directly correlate with intubation difficulty.

Roth et al. [28], in a Cochrane review, reported that airway assessment tests such as Mallampati classification have limited sensitivity (**approximately 50%**) and specificity, and no single test is sufficient. The present study findings support this, as multiple parameters were required to assess difficulty.

Dawood et al. [29] reported that combining Mallampati score with other parameters improved predictive accuracy to approximately **70–75%**. The present study also demonstrated that combined use of MPC and CL grading better reflected intubation difficulty.

Sheff et al. [30] reported that BMI did not significantly correlate with difficult intubation in bariatric patients, with incidence rates not increasing proportionally with BMI. This is consistent with the present study findings. Siddiqui et al. [31] reported that combined Mallampati and Wilson scores improved sensitivity up to **70–80%** in predicting difficult intubation. Although Wilson score was not used in the present study, Mallampati classification alone showed strong association, particularly in higher classes.

Kar et al. [32] demonstrated good correlation between Mallampati classification and Cormack–Lehane grading, with higher Mallampati classes corresponding to higher CL grades. In the present study, CL Grade III was slightly more frequent in males (**4 vs 3 cases**), and higher Mallampati classes were associated with increased difficulty, supporting their findings.

CONCLUSION

The present prospective observational study evaluated the impact of gender variability on intubation difficulty among patients undergoing elective surgeries under

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general anaesthesia. The findings demonstrated that difficult intubation was more frequently observed in males (50%) compared to females (35%), despite both groups being comparable in terms of age and ASA physical status, indicating that gender-related anatomical differences may play a significant role in airway management.

Body mass index (BMI), although traditionally considered an important predictor, did not show a direct correlation with intubation difficulty in this study. Females had relatively higher BMI values; however, the incidence of difficult intubation remained lower compared to males, suggesting that BMI alone is not a reliable predictor of difficult airway.

Mallampati classification emerged as a strong predictor of intubation difficulty, with higher grades (Class III and IV) showing increased association with difficult intubation. This was further supported by intraoperative findings, where higher Cormack–Lehane grades were more frequently observed in patients with difficult airway, particularly among males.

The study highlights that airway assessment should be multifactorial, incorporating clinical predictors such as Mallampati classification and laryngoscopic grading rather than relying on BMI alone. The observed gender differences suggest that male patients may require more careful preoperative airway evaluation and preparedness for potential difficulty during intubation. In conclusion, gender variability appears to influence intubation difficulty, with males demonstrating a higher risk. Mallampati classification remains a valuable predictive tool, whereas BMI alone is insufficient as an independent predictor. These findings emphasize the need for comprehensive airway assessment to improve perioperative safety and outcomes.

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