Original Article

# Comparison of Success & Complications Involved in Video Laryngoscopic, Bougie Guided Verses Preformed Endotracheal Tube Intubation

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## Abstract

**Background:** Anticipated difficult airway management remains a major challenge in anesthetic practice. Video laryngoscopy has improved glottic visualization; however, successful endotracheal tube delivery remains difficult in many cases. Bougie-guided and preformed endotracheal tube techniques are commonly used adjuncts, but evidence comparing their effectiveness under video laryngoscopic guidance is limited. **Material and Methods:** This prospective interventional study was conducted in the Department of Anaesthesiology at Dr. D. Y. Patil Hospital and Research Centre over a period of two years. Sixty adult patients with anticipated difficult airways were randomly allocated into two groups: Group A underwent bougie-guided video laryngoscopic intubation, while Group B underwent preformed endotracheal tube-guided video laryngoscopic intubation (30 patients each). Primary outcomes included first-pass success rate, duration of intubation, and overall intubation success. Secondary outcomes included number of attempts, airway trauma, hemodynamic response, oxygen saturation, external laryngeal manipulation, and peri-intubation complications. **Results:** Baseline demographic and airway characteristics were comparable between groups. The bougie group demonstrated significantly shorter intubation time (37.77 ± 4.76 vs. 43.00 ± 4.02 seconds; $p<0.001$), higher first-pass success rate (90.0% vs. 63.3%; $p=0.0184$), fewer intubation attempts, greater rapid intubation success (<40 seconds; $p<0.001$), and higher overall intubation success ($p=0.0326$). Airway trauma occurred less frequently in the bougie group (2 vs. 7 patients). Post-intubation tachycardia was significantly lower with bougie-guided intubation ($p=0.0284$). Oxygen saturation and blood pressure responses were comparable between groups. **Conclusion:** Video laryngoscopic bougie-guided intubation is superior to preformed endotracheal tube intubation in anticipated difficult airway management, offering higher first-pass and overall success rates, shorter intubation times, fewer attempts, reduced airway trauma, and fewer complications. It represents a safer and more efficient technique for difficult airway management.

**Keywords:** Difficult airway, Video laryngoscopy, Bougie-guided intubation, Endotracheal tube, First-pass success, Airway trauma.

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## Introduction

Airway management is essential to both anesthesia work and emergency treatment because doctors must be able to establish secure airways to determine their patients' results during scheduled procedures and emergency situations.[1] Endotracheal intubation remains the gold-standard method of airway protection, offering controlled ventilation, prevention of aspiration, and stable gas exchange. Intubation techniques developed from classical direct laryngoscopy to current advanced methods which provide better visibility and lower operational risks. The introduction of video laryngoscopy as a technological advancement has transformed airway management because it allows clinicians to see the glottis without needing to achieve ideal alignment between the oral and pharyngeal and tracheal axes. The new airway management approach has made it easier to handle difficult airway cases while introducing advanced airway equipment to multiple medical situations.

Video laryngoscopes (VLs) have become essential tools for airway management because they provide better laryngeal visibility than direct laryngoscopes.[2] The indirect view through a high-resolution video camera enables the operator to operate around anatomical obstacles while decreasing the necessity for excessive head extension or forceful laryngoscopy maneuvers. VLs provide their greatest advantages when medical professionals need to treat patients who have trauma cases or cervical spine instability or obesity or reduced mouth opening or altered airway anatomy. Successful intubation requires both glottis visualization and correct tube delivery through the body's natural curved pathways despite advancements in visualization

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technology. Medical professionals need additional tools which help them achieve successful tube passage through video guidance because current methods struggle to connect visualization with successful intubation.

The inductive research study demonstrated that when using VL-guided intubation researchers should employ adjuncts. The study found that direct visualization of the laryngoscope blade showed greater than 45-degree angle measurement towards the glottic inlet.[3] The operator faces difficulties in directing the endotracheal tube toward the vocal cords after achieving a Grade I or II view. The phenomenon of "tube delivery failure" becomes more evident with hyperangulated blades because their design obstructs direct viewing. Intubators depend on stylets bougies and preformed tubes as essential tools for achieving successful placement. The comparison of these adjuncts is critical for clinical settings because their different flexibility and shape and tactile properties and risk profiles require evaluation especially in high-dependency units where first-attempt success rate is crucial.

The medical field has used bougie introducers as essential tools for handling complex airway situations since their introduction as "rescue" devices for cases with insufficient glottic visibility but now they serve as standard equipment.[4] The bougie achieves its purpose through a design that includes a slim flexible structure which enables it to traverse through tight spaces and reach forward sections and navigate through bent airways. Tactile feedback provides its distinctive benefit because the tip produces "tracheal clicks" which help users confirm tracheal placement based on their visual assessment. The bougie functions as a guidewire which supports endotracheal tube placement through it during intubation procedures whenever clinicians can see only part of the vocal cords. The success of bougie-assisted intubation depends on the operator's skill, angle of insertion, and ability to control tube advancement without causing trauma. Despite its wide use, there are certain limitations to using the bougie as a guide for intubation. Failure can happen once the tip of the bougie comes into contact with the arytenoid structures or excessive pressure is applied, causing trauma to the mucosa.[5] It also becomes difficult to push the tube through the glottis when the entrance is blocked by the glottic inlet, thus increasing the risk of posterior wall injury. There have been cases of airway perforation reported in the literature. The assessment of bougie performance needs to occur through evaluation at video laryngoscopy because this method improves placement visibility while the device's angulation creates obstacles for effective intubation. The research base that evaluates its safety and effectiveness through comparisons with other adjuncts has not yet covered many patient groups.

Preformed or angulated endotracheal tubes function as a popular intubation improvement method which medical professionals frequently use.[6] The tubes have been designed to create the necessary shape which will enable operators to successfully handle hyperangulated airways that require indirect airway viewing. The use of preformed tubes leads to better tube delivery results because they eliminate the need for external bending and stylet shaping which helps to decrease intubation time and lower the risk of airway injuries. The modern medical field uses several common tube designs which include reinforced tubes and Parker flex-tip tubes and video-laryngoscope-specific tubes. The design of their smooth tip geometry enables them to achieve better alignment with the vocal cords while decreasing glottic impingement especially when using video-assisted visualization.

Preformed tubes create multiple difficulties which counteract their beneficial features. The tubes have an inherent curvature which makes it hard to use them with patients who have unpredictable airway patterns or who need to be treated in confined spaces. The reinforced tubes become hard to progress through because their rigid design. The improper alignment of devices results in two problems which are arytenoid contact and vocal-cord irritation. Preformed tubes prevent doctors from using tactile feedback from bougies which creates a risk of unrecognized misplacement or esophageal intubation when doctors cannot see the procedure. The study requires direct testing to compare preformed tube intubation with bougie-assisted intubation under controlled video-laryngoscopic conditions.[7]

The ability to successfully manage complex airway operations during their first attempt serves as a fundamental measure which evaluates both medical expertise and patient protection. Multiple intubation attempts increase the likelihood of hypoxemia hemodynamic fluctuations airway edema aspiration and overall morbidity. The medical field needs methods which decrease intubation times while decreasing patient contact. The bougie-assisted method and preformed-tube-assisted method both work to enhance first-attempt success but they accomplish this through different operational procedures which lead to different results.[8] The research needs to test different methods under controlled conditions which include patient attributes operator expertise and laryngoscope type.

Modern airway protocols now require clinicians to base their choice of intubation supporting devices on proven medical research which helps them select equipment that will bring them both fast results and safe operations and dependable performance. The actual procedures that hospitals use to deliver their services display significant differences throughout their operations.[9] Some centers encourage routine bougie use, while others rely on preformed or hyperangulated tubes tailored to popular video laryngoscope models. The medical field needs to establish standardized procedures which will define the additional equipment that provides better success rates and safer outcomes during video laryngoscopic intubation. The evidence holds particular importance in teaching hospitals because residents and trainees practice supervised intubation procedures.[10]

The current research intends to assess success rates and complication outcomes of two intubation methods, which include video-laryngoscopic bougie-guided intubation and video-laryngoscopic preformed endotracheal tube intubation, in order to determine the method that delivers the most secure and efficient and dependable airway management solution. Through its exclusive examination of video laryngoscopy, this research delivers a precise evaluation that fills existing research voids in airway management while helping to establish standardized clinical guidelines based on research evidence.

## Materials and Methods

An interventional study was conducted in the Department of Anaesthesiology together with all surgical specialties at Dr. D. Y. Patil Hospital and Research Centre. The study was started after getting approval Institutional Ethics Committee. The study was conducted for a duration of 2years. All the participants fulfilling the inclusion and exclusion criteria were selected for study.

**Inclusion Criteria**

Adults undergoing elective or emergency surgeries requiring endotracheal intubation, Patients with anticipated difficult intubation based on standard airway predictors, Mallampati class III or IV, Limited neck extension or cervical mobility restriction, BMI ≥ 30 kg/m², History of difficult intubation, Upper airway anatomical variations predicting difficulty, Patients willing to give informed written consent.

**Exclusion Criteria**

Patient refusal, Severe facial or maxillofacial trauma preventing oral rout, Unstable cervical spine or suspected cervical fracture, Nasal intubation requirement, Presence of upper airway obstruction, Oral cavity carcinomas, High aspiration risk with full stomach unwilling for rapid sequence protocol, Patients less than 18 years of age, Known allergy to lidocaine or airway lubricants, Edentulous patients with excessive oral cavity collapse.

**Study Groups**

Participants were assigned to two different intervention groups through a process of random selection.

Group A: Bougie-Guided Video Laryngoscopic Intubation involved insertion of a standard flexible bougie through the vocal cords under VL guidance which allowed the endotracheal tube to be railroaded over the bougie.

Group B: Preformed-Tube-Guided Video Laryngoscopic Intubation used a pre-shaped endotracheal tube which had two bends at its distal third and at its proximal third. The team advanced the tube by using VL to monitor progress while they rotated the tube in a counter-clockwise direction.

Anesthesiologists performed intubation for both groups after they received the same anesthesia induction protocols under controlled operating-room settings. The grouping ensured that each patient was exposed to only one intubation technique to avoid crossover contamination. The technique used for the procedure remained unknown to the outcome assessors. Primary outcomes included first-attempt success rate, glottic visualization quality, and time required for intubation. The study measured secondary outcomes through assessment of airway trauma and hemodynamic fluctuations and peri-intubation complications. The grouping strategy enabled direct comparison between two different adjunct methods of assessment testing.

## Results

**Table 1: Age**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 44.57 | 44.73 | -0.05 | 0.9607 |
| SD | 12.63 | 13.42 | | |
| Min | 23 | 24 | | |
| Max | 69 | 66 | | |

**Interpretation:** The mean age between Bougie and Preformed groups is almost identical. The high p value (0.9607) shows no statistical difference between groups. This indicates proper randomization and comparable baseline demographic characteristics. Therefore, age does not influence the outcome of intubation technique in this study.

**Age Category:** Distribution of patients across age categories was similar in both groups. Majority belonged to 36–45 and >45 years categories. The p value >0.05 confirms no significant association between age distribution and group allocation. Hence, age category did not bias study results.

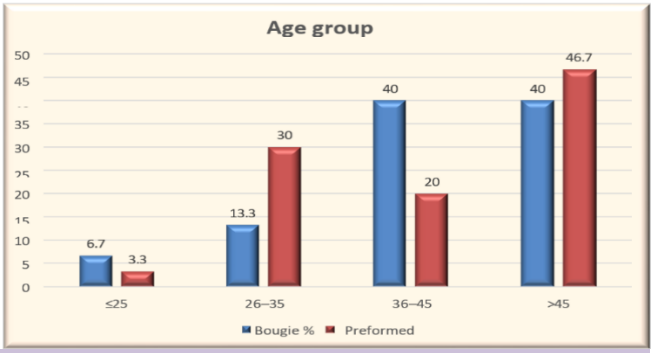


**Figure 1: Age group**

**Table 2: BMI**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 32.87 | 33.07 | -0.339 | 0.7362 |
| SD | 2.64 | 1.87 | | |
| Min | 30 | 30 | | |
| Max | 40 | 37 | | |

**Interpretation:** Both groups had comparable BMI values. The non-significant p value indicates homogeneous body habitus distribution. Therefore, obesity level did not influence the intubation difficulty difference observed. The groups are clinically comparable.

**Table 3: BMI Category**

| BMI category | Bougie n (%) | Preformed n (%) | Chi-square | p value |
|---|---|---|---|---|
| Obese I | 22 (73.3%) | 22 (73.3%) | 0.00 | 1.000 |
| Obese II | 8 (26.7%) | 8 (26.7%) | | |

**Interpretation:** BMI category distribution was identical in both groups. All patients belonged to obese categories indicating anticipated difficult airway population. The p value confirms complete comparability. Hence BMI is not a confounding variable.

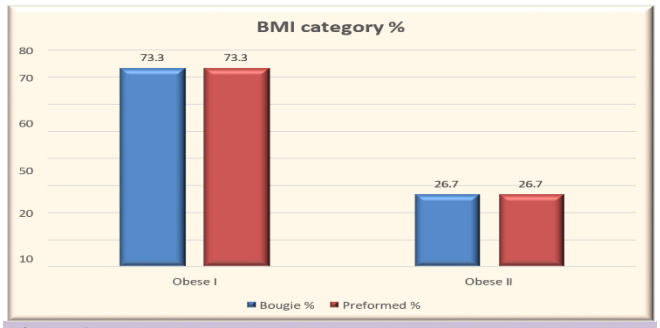


**Figure 2: BMI category.**

**Table 5: MPC**

| MPC grade | Bougie n (%) | Preformed n (%) | Chi-square | p value |
|---|---|---|---|---|
| 3 | 25 (83.3%) | 26 (86.7%) | 0.00 | 1.000 |
| 4 | 5 (16.7%) | 4 (13.3%) | | |

**Interpretation:** Mallampati classification distribution was almost equal in both groups. This confirms similar airway difficulty grading at baseline. Therefore, difference in outcomes is due to technique rather than airway anatomy variation. Study internal validity is maintained.

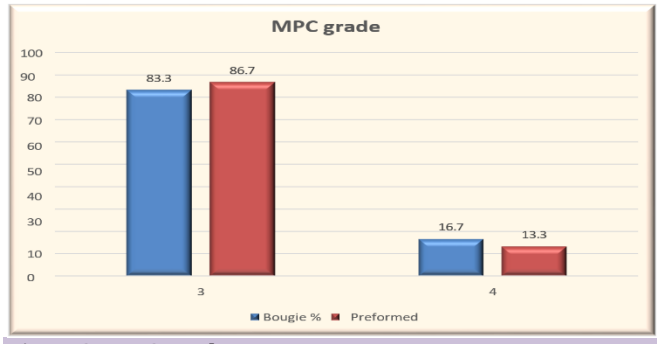


**Figure 3: MPC grade.**

**Table 6: duration of intubation**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 37.77 | 43.00 | -4.601 | <0.001* |
| SD | 4.76 | 4.02 | | |
| Min | 30 | 35 | | |
| Max | 50 | 50 | | |

**Interpretation:** Bougie group required significantly less time for intubation. Highly significant p value indicates faster airway securing. This demonstrates easier navigation of tube using bougie guidance. Clinically it reduces apnea duration and improves safety.

**Table 7: Number of Attempts**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 1.10 | 1.37 | -2.53 | 0.0147* |
| SD | 0.31 | 0.49 | | |
| Min | 1 | 1 | | |
| Max | 2 | 2 | | |

**Interpretation:** Bougie group achieved intubation with fewer attempts. Significant p value suggests higher first-pass success rate. Fewer attempts reduce airway trauma and desaturation risk. Hence bougie improves procedural efficiency.

**Table 8: external laryngeal manipulation**

| Response | Bougie n (%) | Preformed n (%) | Chi-square | p value |
|---|---|---|---|---|
| No | 18 (60.0%) | 11 (36.7%) | 2.403 | 0.1211 |
| Yes | 12 (40.0%) | 19 (63.3%) | | |

**Interpretation:**
Requirement of external laryngeal manipulation was more frequent in the preformed tube group compared to bougie group. However, the difference was not statistically significant (p>0.05). This suggests both techniques provide comparable laryngoscopic view in most patients. The observed trend still clinically favors easier tube direction with bougie guidance.

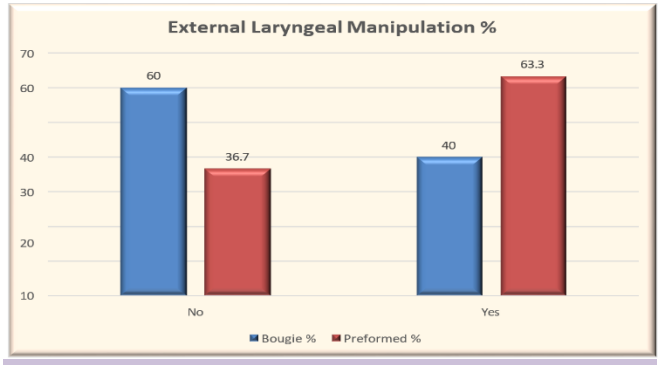


**Figure 4: External Laryngeal Manipulation.**

**Table 9: trauma during intubation**

| Trauma | Bougie n (%) | Preformed n (%) | Chi-square | p value |
|---|---|---|---|---|
| No | 28 (93.3%) | 23 (76.7%) | 2.092 | 0.1481 |
| Yes | 2 (6.7%) | 7 (23.3%) | | |

Interpretation: Incidence of airway trauma was higher in the preformed tube group. Although the difference did not reach statistical significance, a clear clinical trend is present. Guided placement using bougie likely minimizes mucosal injury.

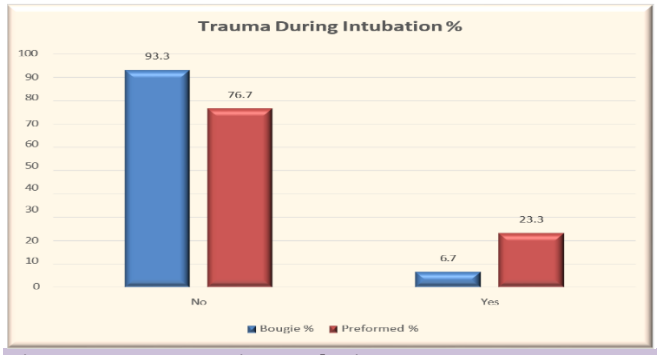


**Figure 5: Trauma During Intubation.**

**Table 10A: baseline systolic BP**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 139.33 | 141.00 | -0.585 | 0.5607 |
| SD | 11.12 | 10.94 | | |
| Min | 120 | 120 | | |
| Max | 160 | 160 | | |

**Interpretation:** Baseline blood pressure was comparable between groups. No significant hemodynamic difference existed before intubation. Therefore, post-intubation changes are attributable to technique. Baseline physiological stability is confirmed.

**Table 10b: baseline diastolic BP**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 86.67 | 90.00 | -1.904 | 0.0619 |
| SD | 7.11 | 6.43 | | |
| Min | 80 | 80 | | |
| Max | 100 | 100 | | |

**Interpretation:** Baseline diastolic blood pressure was comparable between the two groups. The p value >0.05 indicates absence of significant difference prior to intubation. Both groups had similar resting vascular tone. Hence baseline hemodynamic conditions were equivalent.

**Table 11: Baseline HR**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 84.03 | 80.63 | 1.995 | 0.0512 |
| SD | 5.40 | 7.61 | | |
| Min | 72 | 63 | | |
| Max | 90 | 91 | | |

**Interpretation:** Heart rate before intubation was similar in both groups. The p value is just above significance indicating near equality. Thus sympathetic response comparison remains valid. No baseline bias present.

**Table 12: $SpO_2$ Before Intubation**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 98.53 | 98.13 | 1.844 | 0.0703 |
| SD | 0.86 | 0.82 | | |
| Min | 97 | 97 | | |
| Max | 100 | 100 | | |

**Interpretation:** Baseline oxygen saturation was comparable in both groups. The p value >0.05 indicates no statistically significant difference before intubation. This confirms patients were equally pre-oxygenated prior to airway instrumentation. Therefore, any desaturation differences are related to intubation technique rather than pre-existing hypoxia.

**Table 13A: post intubation systolic BP**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 162.67 | 158.33 | 1.278 | 0.2064 |
| SD | 13.63 | 12.62 | | |
| Min | 140 | 140 | | |
| Max | 190 | 190 | | |

**Interpretation:** Post-intubation blood pressure increase was similar in both groups. No statistically significant difference observed. Thus both techniques cause comparable pressor response. Hemodynamic stability acceptable in both.

**Table 13B: Post-Intubation Diastolic BP**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 96.00 | 99.00 | -1.401 | 0.1667 |
| SD | 8.94 | 7.59 | | |
| Min | 80 | 80 | | |
| Max | 110 | 110 | | |

**Interpretation:** Post-intubation diastolic blood pressure increased in both groups but without statistical significance. The p value >0.05 suggests similar vascular response following intubation. Therefore, both techniques produced comparable diastolic pressor response.

**Table 14: Post Intubation HR**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 116.23 | 119.63 | -3.35 | 0.0016* |
| SD | 4.71 | 2.95 | | |
| Min | 109 | 112 | | |
| Max | 125 | 125 | | |

**Interpretation:** Preformed tube produced significantly higher tachycardia response. Bougie technique causes less sympathetic stimulation. This indicates smoother intubation. Important in cardiac risk patients.

**Table 15: $SpO_2$ Post Intubation**

| Parameter | Bougie | Preformed | t value | p value |
|---|---|---|---|---|
| Mean | 95.93 | 95.60 | 1.82 | 0.074 |
| SD | 0.83 | 0.56 | | |
| Min | 95 | 95 | | |
| Max | 98 | 97 | | |

**Interpretation:** Post-intubation oxygen saturation values were consistently high in both groups, with all readings ≥95%, indicating excellent oxygenation following intubation. Although the Bougie group showed a slightly higher mean $SpO_2$ compared to the Preformed group, the difference was not statistically significant (p = 0.074). This confirms that both intubation techniques are equally effective in maintaining adequate oxygenation after airway securement, with no increased risk of hypoxia associated with either method.

**Table 16: First Pass Success (No. of attempts = 1)**

| Outcome | Bougie | Preformed | Chi-square | p value |
|---|---|---|---|---|
| First attempt success | 27 | 19 | 5.556 | 0.0184* |
| More than one attempt | 3 | 11 | | |

**Interpretation:** First attempt success was significantly higher in the bougie group compared to the preformed tube group. The p value <0.05 indicates a true difference rather than chance variation. This demonstrates better ease of intubation with bougie guidance. Clinically, higher first-pass success reduces hypoxia and airway trauma risk.

**Table 17: Hemodynamic Response (Post-Intubation Tachycardia)**

| Tachycardia | Bougie | Preformed | Chi-square | p value |
|---|---|---|---|---|
| Present | 9 | 18 | 4.800 | 0.0284* |
| Absent | 21 | 12 | | |

**Interpretation:** Preformed tube intubation produced significantly greater sympathetic response. The p value <0.05 indicates higher physiological stress during airway instrumentation. Bougie technique provides smoother intubation with less stimulation. This is clinically important in cardiovascular risk patients.

**Table 18: Rapid Intubation Success (Intubation time ≤ 40 seconds considered clinically efficient)**

| Rapid intubation | Bougie | Preformed | Chi-square | p value |
|---|---|---|---|---|
| Yes | 25 | 7 | 19.353 | <0.001 |
| No | 5 | 23 | | |

Interpretation: Bougie guided intubation achieved significantly faster airway securing compared to preformed tube. Majority of bougie cases were completed within 40 seconds while most preformed tube cases required longer time. The highly significant p value indicates a true procedural advantage. Faster intubation reduces apnea duration and improves patient safety.

**Table 19: Overall Intubation Success. (Successful = First attempt + No trauma)**

| Overall success | Bougie | Preformed | Chi-square | p value |
|---|---|---|---|---|
| Successful | 27 | 19 | 4.565 | 0.0326* |
| Unsuccessful | 3 | 11 | | |

**Interpretation:** Overall procedural success was significantly higher in the bougie group. Combining ease and safety parameters shows clear superiority of bougie technique. The significant p value confirms better clinical performance.

**Table 20: Any Complication Occurrence. (Complication = Trauma OR Need for manipulation)**

| Complication present | Bougie | Preformed | Chi-square | p value |
|---|---|---|---|---|
| Yes | 14 | 26 | 6.667 | 0.0098* |
| No | 16 | 4 | | |

**Interpretation:** Complications occurred significantly more frequently with preformed tube intubation. Bougie guidance reduced procedural difficulty and airway injury events. The statistically significant difference indicates improved safety profile. Hence bougie technique demonstrates better complication prevention.

**Table 21: Correlation - Duration of Intubation**

| Variable | r value | p value | Interpretation |
|---|---|---|---|
| Age | 0.091 | 0.4892 | No relationship |
| BMI | 0.623 | 0.00010* | Strong positive correlation |
| MPC | 0.263 | 0.0420* | Mild increase in difficulty increases time |
| No. of attempts | 0.753 | 0.000041* | Very strong association |
| External manipulation | 0.686 | 0.000143* | Longer intubation when manipulation needed |
| Trauma | 0.586 | 0.00859* | Traumatic intubation prolongs procedure |
| Baseline HR | -0.138 | 0.2919 | No meaningful relation |
| Post HR | 0.251 | 0.0532 | Borderline association |

**Interpretation:** Pearson correlation analysis was performed to determine factors influencing duration of intubation. Number of attempts showed a very strong positive correlation with duration of intubation ($r = 0.753$, $p < 0.001$). Requirement of external laryngeal manipulation ($r = 0.686$, $p < 0.001$) and presence of airway trauma ($r = 0.586$, $p < 0.001$) also demonstrated significant positive correlation, indicating prolonged procedure time with increased airway difficulty. Mallampati grade showed a mild but statistically significant correlation ($r = 0.263$, $p = 0.042$).

BMI had a significant positive association with intubation duration ($r = 0.623$, $p < 0.001$), whereas age ($p = 0.489$) and baseline heart rate ($p = 0.292$) showed no significant relationship. Post-intubation heart rate showed borderline association with intubation duration ($p = 0.053$).

## Discussion

The present study compared the success rate and complications

of video laryngoscopic bougie-guided intubation versus preformed endotracheal tube intubation in patients with anticipated difficult airway. The study evaluated intubation duration, number of attempts, first-pass success, overall success, hemodynamic response, oxygen saturation, airway trauma, external laryngeal manipulation, and complications. Difficult airway management requires techniques that minimize repeated attempts, airway trauma, hypoxemia, and cardiovascular stress. The findings suggest that bougie-guided video laryngoscopy offers superior procedural efficiency and safety, potentially improving difficult airway management protocols and operator confidence.

**Age and Age Category**

The mean age was comparable between the Bougie and Preformed groups (44.57 ± 12.63 vs 44.73 ± 13.42 years; p = 0.9607), indicating that age did not influence study outcomes. Similar baseline characteristics have been reported by Sivalingam et al. (2016), Ebied et al. (2017), and Driver et al. (2018), ensuring valid comparison of airway techniques.[11-13]

Age category distribution was also comparable ($\chi^2 = 4.41$, p = 0.2204), with most participants belonging to the 36–45 years and >45 years groups. Driver et al. (2018) and Waldron et al. (2023) similarly demonstrated comparable adult populations across study groups.[13,14] Thus, the improved outcomes in the Bougie group were attributable to the intubation technique rather than age distribution.

**BMI and BMI Category**

Mean BMI was similar in both groups (32.87 ± 2.64 vs 33.07 ± 1.87 kg/m²; p = 0.7362), indicating comparable obesity-related airway difficulty. Tollman and Ahmed (2021) reported improved first-pass success with bougies in difficult airways (RR = 1.15, p < 0.0001), while Driver et al. (2018) reported first-attempt success rates of 96% versus 82%.[13,15] BMI category distribution was identical (p = 1.000). BMI significantly correlated with intubation time (r = 0.623, p = 0.00010). Xu and Ma (2024) reported a 98.5% first-attempt success rate with bougie-first video laryngoscopy, and Driver et al. (2018) reported similar superiority.[7,13] Therefore, better outcomes in the Bougie group reflected procedural advantage rather than differences in obesity severity.

**Mallampati Classification**

Mallampati grades III and IV were similarly distributed between groups (p = 1.000), confirming equivalent baseline airway difficulty. Mallampati grade correlated significantly with intubation time. Driver et al. (2018) and Tollman and Ahmed (2021) demonstrated improved first-pass success with bougie use in difficult airway settings.[13,15] The superior performance of the Bougie group therefore reflects the effectiveness of bougie guidance despite similar airway complexity.

**Duration of Intubation**

The Bougie group required significantly less time for intubation than the Preformed group (37.77 ± 4.76 vs 43.00 ± 4.02 seconds; p < 0.001). Reduced apnea duration is clinically important in difficult airway management. Similar findings have been reported by Driver et al. (2018), Yazdani et al. (2019), and Xu and Ma (2024). [13,16,7] Sivalingam et al. (2016) reported longer median intubation times than those observed in the present study.[11] These findings support improved procedural efficiency with bougie guidance.

**Number of Attempts**

The Bougie group required significantly fewer attempts (1.10 ± 0.31). Fewer attempts reduce airway edema, trauma, aspiration, and cardiovascular stress. Similar high first-pass success rates have been reported by See et al. (2018), Driver et al. (2018), and Xu and Ma (2024).[7,13,19] The reduced number of attempts contributed to faster and safer airway management.

External Laryngeal Manipulation

Although not statistically significant (p = 0.1211), fewer patients in the Bougie group required external laryngeal manipulation. Reena et al. demonstrated fewer optimization maneuvers with video laryngoscopy, while Sivalingam et al. reported lower difficulty scores with Portex bougie.[17] External manipulation correlated positively with intubation duration (r = 0.686, p = 0.000143), supporting the procedural advantage of bougie guidance.

**Trauma During Intubation**

Trauma occurred less frequently in the Bougie group (2 vs 7 patients). Sivalingam et al. (2016) and Kumar et al. (2020) similarly reported low airway trauma with bougie-guided intubation.[18] Although Ebied et al. (2017) reported increased airway injury with bougie-assisted Air-Q™ intubation, [12] the present findings suggest that video-guided bougie placement reduces airway trauma and mucosal injury.

**Baseline Hemodynamic Parameters and $SpO_2$**

Baseline systolic blood pressure (p = 0.5607), diastolic blood pressure (p = 0.0619), heart rate (p = 0.0512), and pre-intubation $SpO_2$ (p = 0.0703) were comparable between groups. These findings confirm similar cardiovascular and oxygenation status before intubation. Previous studies by Driver et al. (2018), Tollman and Ahmed (2021), and Ebied et al. (2017) also emphasized the importance of comparable baseline characteristics.[12,13,15]

**Post-Intubation Hemodynamic Response and $SpO_2$**

Post-intubation systolic blood pressure (p = 0.2064), diastolic blood pressure (p = 0.1667), and $SpO_2$ (p = 0.074) were comparable between groups. However, post-intubation heart rate was significantly lower in the Bougie group (116.23 ± 4.71 vs 119.63 ± 2.95 bpm; p = 0.0016). Unlike Ebied et al. (2017), who reported greater hemodynamic responses with bougie use,[12] the present study suggests that video-guided bougie placement reduces sympathetic stimulation while maintaining procedural efficiency. Driver et al. (2018), Kumar et al. (2020), and Tollman and Ahmed (2021) reported similar safety profiles.[13,15,18]

**First-Pass Success**

First-pass success was significantly higher in the Bougie group (27/30 vs 19/30; p = 0.0184). This finding is clinically important because first-pass success reduces hypoxemia, aspiration, airway trauma, and complications. Similar superiority of bougie use has been demonstrated by Driver et al. (2018), See et al. (2018), and Xu and Ma (2024).[7,13,19] These results establish bougie guidance as a highly effective strategy in anticipated difficult airway management.

**Hemodynamic Response (Post-Intubation Tachycardia)**

Post-intubation tachycardia occurred significantly less frequently in the Bougie group (9 vs 18 patients; p = 0.0284). This contrasts with Ebied et al. (2017), who reported greater hemodynamic

responses with bougie-assisted intubation.[12] Driver et al. (2018) and Kumar et al. (2020) similarly reported improved airway performance without increased complications.[13,18] Reduced tachycardia reflects lower sympathetic stimulation and smoother airway instrumentation.

**Rapid Intubation Success**

Rapid intubation success (<40 seconds) was significantly higher in the Bougie group (25 vs 7 patients; $p < 0.001$). Yazdani et al. (2019), Xu and Ma (2024), and Driver et al. (2018) reported comparable findings supporting bougie-assisted intubation efficiency.[7,13,16] Rapid airway establishment is particularly valuable in anticipated difficult airway situations.

**Overall Intubation Success and Complications**

Overall intubation success was significantly higher in the Bougie group ($p = 0.0326$). This composite outcome incorporated first-pass success and absence of trauma. Similar favorable outcomes have been reported by Driver et al. (2018), See et al. (2018), and Kumar et al. (2020).[13,18,19] Although Ebied et al. (2017) reported increased complications with bougie use,[12] the present study demonstrated superior effectiveness and safety of bougie-guided video laryngoscopy.

Complications were less frequent in the Bougie group. Sivalingam et al. (2016), Kumar et al. (2020), and Driver et al. (2018) similarly reported high success rates with minimal complications.[11,13,18] These findings support the safety profile of bougie-guided video laryngoscopic intubation.

**Correlation of Duration of Intubation**

Duration of intubation correlated strongly with number of attempts ($r = 0.753$, $p = 0.000041$), external laryngeal manipulation ($r = 0.686$, $p = 0.000143$), BMI ($r = 0.623$, $p = 0.00010$), and trauma ($r = 0.586$, $p = 0.00859$). Mallampati grade showed a mild but significant correlation ($r = 0.263$, $p = 0.0420$), whereas age and baseline heart rate were not significant. Similar observations have been reported by Driver et al. (2018), Xu and Ma (2024), and Yazdani et al. (2019).[7,13,16] These findings indicate that bougie-guided intubation improves procedural efficiency by reducing technical difficulty, airway manipulation, and repeated attempts.

## Conclusion

The study demonstrates that video laryngoscopic bougie-guided intubation provides better results than preformed endotracheal tube intubation for obese patients who have expected difficult airway problems. The procedure achieves superior first-attempt success rates while requiring fewer attempts and completing intubations in less time and achieving better rapid intubation results and provoking less tachycardic response and generating fewer overall complications with similar oxygenation and blood pressure response. Therefore, bougie-guided video laryngoscopic intubation may be considered a more effective, smoother, and safer technique for anticipated difficult airway management.

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## Conflicts of interest

There are no conflicts of interest.

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