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Airway Management Strategies and Outcomes During Endoscopic Retrograde Cholangiopancreatography

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ABSTRACT

Background: *Endoscopic Retrograde Cholangiopancreatography (ERCP) requires adequate sedation or anesthesia, but airway management remains challenging due to prone positioning and shared airway access. This study aimed to evaluate airway management strategies and their associated clinical outcomes during ERCP.* ***Methods & Materials:*** *This prospective observational study was conducted at the Department of Gastroenterology, Popular Medical College Hospital and Popular Diagnostic Centre PLC Limited, Dhaka, Bangladesh, over six months from November 2025 to April 2026. A total of 200 adult patients undergoing ERCP were included using purposive consecutive sampling. Airway management techniques, peri-procedural events and outcomes were recorded. Data were analyzed using SPSS version 25.0, with appropriate descriptive and inferential statistics applied.* ***Results:*** *Among 200 patients, the cohort was balanced for gender (51% male) with the largest age group being 51–60 years (21.5%). Monitored anesthesia care (MAC) was the most common airway strategy (43.5%), followed by SAD (26.0%) and ETT (23.5%). Hypotension (21.0%) and oxygen desaturation (19.0%) were the leading complications; 40.5% had no complications. Desaturation rates varied significantly by airway strategy (p = 0.012): highest with MAC (25.3%) and lowest with ETT (8.5%).* ***Conclusion:*** *Sedation-based airway management is commonly used during ERCP but is associated with a higher risk of oxygen desaturation. Careful selection of airway strategy and vigilant monitoring are essential to improve patient safety and outcomes.*

Keywords: *ERCP, airway management, sedation, oxygen desaturation, endotracheal intubation.*

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INTRODUCTION

Endoscopic Retrograde Cholangiopancreatography (ERCP) is an advanced diagnostic and therapeutic procedure widely used for the management of pancreaticobiliary disorders [1]. The procedure is often lengthy and technically demanding, requiring deep sedation or general anesthesia to ensure patient comfort, immobility and optimal procedural conditions [2]. However, ERCP poses unique challenges to airway management due to the prone or semi-prone positioning of patients, shared airway with the endoscopist and the risk of hypoventilation, aspiration and oxygen desaturation. These factors increase the likelihood of airway-related complications compared with many other endoscopic procedures [3,4].

Various airway management strategies are employed during ERCP, including monitored anesthesia care (MAC) with spontaneous ventilation, supraglottic airway devices and endotracheal intubation [5]. Each approach has its advantages and limitations regarding safety, ease of airway control, risk of respiratory events, recovery time and procedural efficiency. While deeper sedation may enhance patient tolerance and reduce procedure time, inadequate airway protection can lead to hypoxia or aspiration [6]. Conversely, endotracheal intubation provides a secure airway but may increase anesthesia time, hemodynamic fluctuations and resource utilization [7].

Given these considerations, selecting the most appropriate airway management technique is crucial to improve patient safety and clinical outcomes [8]. However, evidence comparing the effectiveness and complications of different strategies during ERCP remains limited, particularly in resource-limited settings [9].

The objective of this study was to evaluate the airway management strategies used during Endoscopic Retrograde Cholangiopancreatography (ERCP) and their associated clinical outcomes among patients undergoing the procedure.

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METHODS & MATERIALS

This prospective observational study was conducted at the Department of Gastroenterology, Popular Medical College Hospital and Popular Diagnostic Centre PLC Limited, Dhaka, Bangladesh, over a period of six months from November 2025 to April 2026. The study population comprised all adult patients undergoing Endoscopic Retrograde Cholangiopancreatography (ERCP) under sedation or anesthesia during the study period. A total sample size of 200 patients was included using a purposive consecutive sampling technique, where all eligible patients were enrolled consecutively. Inclusion criteria were patients aged ≥18 years, scheduled for elective ERCP, receiving sedation or anesthesia and providing informed written consent. Patients with incomplete clinical data, those requiring emergency airway intervention before the procedure, known upper airway abnormalities or anticipated difficult airway requiring planned advanced airway management, severe cardiopulmonary instability (e.g., shock or respiratory failure) and those refusing consent were excluded. Data were collected using a structured questionnaire, patient medical records, anesthesia charts, ERCP procedure records and standard monitoring devices including pulse oximetry and capnography. Pre-procedure data included demographic characteristics, medical history, comorbidities and baseline vital signs. Intra-procedural data comprised airway management technique, sedative or anesthetic agents, procedure duration and peri-procedural monitoring parameters. Airway-related events such as oxygen desaturation, airway obstruction, laryngospasm and need for intervention, along with hemodynamic changes, were documented. Post-procedure outcomes including recovery time, complications and need for additional airway support were recorded. Data were entered and analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Categorical variables were presented as frequencies and percentages. Chi-square or Fisher's exact test were applied as appropriate, used to identify associated factors. A p-value <0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Review Board (PMC/IEthicalRB/2026/054), and patient confidentiality was strictly maintained.

RESULTS

Table I presents the distribution of patients by age and gender (N = 200). The cohort included 102 males (51.0%) and 98 females (49.0%). The most frequent age group was 51–60 years (n = 43, 21.5%), followed by 41–50 years (n = 35, 17.5%). The smallest group was patients aged ≥71 years (n = 24, 12.0%).

Table I: Distribution of Patients by Age and Gender (*n* = 200)

Variable	Frequency (n)	Percentage (%)
Gender		
Male	102	51.0
Female	98	49.0
Age Group (years)		
20–30	34	17.0
31–40	33	16.5
41–50	35	17.5
51–60	43	21.5
61–70	31	15.5
≥71	24	12.0
Total	200	100

Table II outlines the airway management strategies employed during ERCP. Among the 200 patients, monitored anesthesia care (MAC) with spontaneous breathing was the most frequently used technique, utilized in 87 patients (43.5%). A supraglottic airway device (SAD) was placed in 52 patients (26.0%), and endotracheal intubation (ETT) was performed in 47 patients (23.5%). Conversion to intubation from another airway method was required in 14 cases (7.0%).

Table II: Distribution of Airway Management Strategies During ERCP (*n* = 200)

Airway Technique	Frequency (n)	Percentage (%)
Sedation with spontaneous breathing (MAC)	87	43.5
Supraglottic airway device (SAD)	52	26.0
Endotracheal intubation (ETT)	47	23.5
Conversion to intubation	14	7.0
Total	200	100

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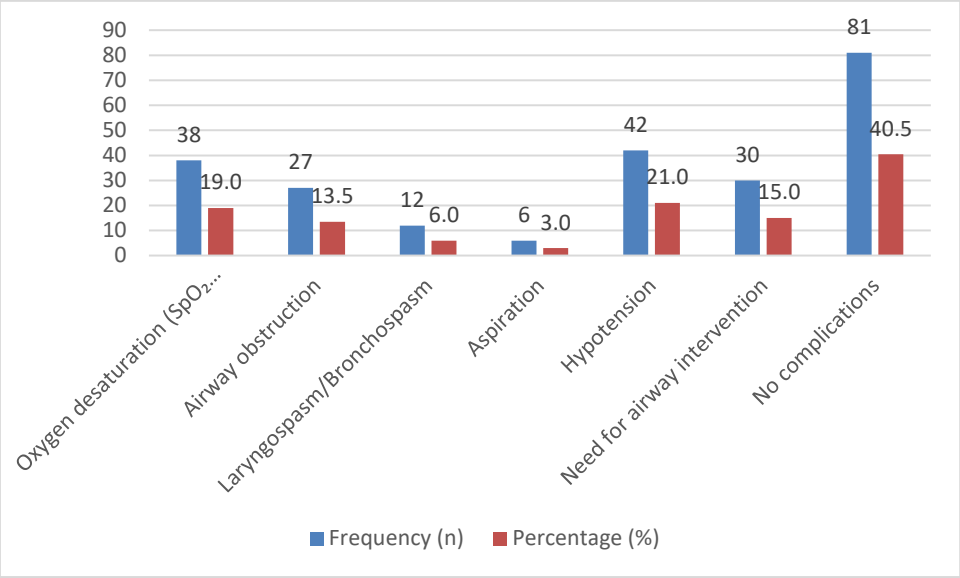

Figure 1: Airway-related and Peri-procedural Complications (*n* = 200)

Figure 1 presents the airway-related and peri-procedural complications observed in the study cohort. Multiple complications were observed in some patients; therefore, the total frequency exceeds the study population (n = 200). Among the 200 patients, 81 (40.5%) experienced no complications. The most frequently encountered complication was hypotension, occurring in 42 patients (21.0%), followed by oxygen desaturation (SpO_2 < 90%) in 38 patients (19.0%). The need for airway intervention arose in 30 patients (15.0%). Airway obstruction was documented in 27 cases (13.5%), while laryngospasm or bronchospasm occurred in 12 patients (6.0%). Aspiration was the least common complication, observed in 6 patients (3.0%).

Table III shows the association between airway management strategy and the occurrence of oxygen desaturation (SpO_2 < 90%). The highest rate of desaturation was observed in the MAC group, where 22 out of 87 patients (25.3%) experienced desaturation, compared with 65 patients (74.7%) who did not. In the SAD group, desaturation occurred in 9 patients (17.3%), while 43 patients (82.7%) had no desaturation. The ETT group had the lowest desaturation rate, with only 4 patients (8.5%) experiencing desaturation and 43 patients (91.5%) remaining without desaturation. Among patients who required conversion to intubation, 3 out of 14 (21.4%) had desaturation. The association between airway strategy and oxygen desaturation was statistically significant (p = 0.012).

Table III: Association Between Airway Strategy and Oxygen Desaturation (*n* = 200)

Airway Strategy	Desaturation Present n (%)	No Desaturation n (%)	P-value
MAC	22 (25.3)	65 (74.7)	0.012
SAD	9 (17.3)	43 (82.7)	
ETT	4 (8.5)	43 (91.5)	
Conversion to ETT	3 (21.4)	11 (78.6)	

DISCUSSION

The present prospective observational study evaluated airway management strategies and their associated outcomes during ERCP in a Bangladeshi population, demonstrating that sedation with spontaneous breathing (MAC) was the most commonly used technique (43.5%), followed by supraglottic airway devices (26.0%) and endotracheal intubation (23.5%). These findings are consistent with existing literature, where sedation-based approaches are frequently preferred due to simplicity and faster recovery. For instance, Smith et al., reported widespread use of conscious sedation during ERCP with acceptable safety profiles, although anesthesia-based approaches may offer better airway control in selected cases [10]. Similarly, Hui et al., highlighted that sedation techniques improve patient comfort and procedural feasibility, supporting the high utilization of MAC observed in our study [11].

In the current study, airway-related complications were not uncommon, with hypotension (21.0%) and oxygen desaturation (19.0%) being the most frequent events. These findings align with De Vico et al., who demonstrated that deep sedation with spontaneous breathing is feasible but carries a risk of respiratory compromise, particularly hypoxia [12]. Liu et al. also reported variability in complication rates depending on sedative regimens, reinforcing that airway and hemodynamic instability remain important concerns during ERCP [13]. The relatively low incidence of aspiration (3.0%) and laryngospasm/bronchospasm (6.0%) in our study is comparable to previously published data, indicating that severe airway complications are less frequent but still clinically significant.

A key finding of this study was the significant association between airway management strategy and oxygen desaturation (p = 0.012). Patients managed with MAC had the highest rate of desaturation (25.3%), whereas those undergoing endotracheal intubation had the lowest rate (8.5%). This observation is consistent with the pro-con debate highlighted by Janik et al., where MAC is associated with

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higher risk of hypoventilation compared to general anesthesia with a secured airway [14]. Similarly, Abuassi et al., demonstrated improved airway safety with general anesthesia compared to MAC, particularly in high-risk patients [15]. The lower desaturation rates observed in the ETT group in our study further support the role of definitive airway control in minimizing respiratory events during ERCP.

The use of supraglottic airway devices (SAD) in 26.0% of patients with intermediate desaturation rates (17.3%) reflects their growing role as a balance between sedation and intubation. De A et al., reported that advanced supraglottic devices provide effective ventilation and may reduce airway-related complications during ERCP under general anesthesia [16]. This supports our findings, where SAD demonstrated better airway stability compared to MAC but slightly higher risk than ETT.

Conversion to intubation occurred in 7.0% of cases, indicating that initial airway strategies may sometimes be inadequate. This is comparable to findings from Apinyachon et al., who emphasized the importance of preparedness for airway escalation during ERCP due to procedural complexity and patient positioning [17]. Additionally, the prone or semi-prone positioning during ERCP, as discussed by Mansoor et al., inherently increases airway risk and necessitates careful monitoring and timely intervention [18].

Recent advances in oxygenation strategies, such as high-flow nasal oxygen, have shown promise in reducing hypoxia during ERCP. Song et al., and Chadha et al., demonstrated improved oxygenation and reduced desaturation with high-flow nasal cannula compared to conventional oxygen therapy [19,20]. Although not specifically evaluated in our study, these findings suggest potential avenues to improve outcomes in patients managed with MAC.

LIMITATIONS

This study has several limitations that should be considered while interpreting the findings. Being a single-center prospective observational study, the results may not be generalizable to all settings. The use of purposive consecutive sampling may introduce selection bias and the absence of randomization limits the ability to establish causal relationships between airway strategies and outcomes. Variations in sedation techniques and anesthetic agents may also have influenced the observed complication rates.

CONCLUSION

In conclusion, sedation with spontaneous breathing, following MAC protocol was the most commonly employed airway management strategy during ERCP; however, it was associated with a higher incidence of oxygen desaturation compared to endotracheal intubation. Supraglottic airway devices provided an intermediate level of airway safety. Although most patients had uneventful outcomes, airway-related complications were not uncommon. Careful selection of airway management technique, along with vigilant monitoring and readiness for airway intervention, is essential to improve patient safety and optimize clinical outcomes during ERCP.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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