



Anesthetic Challenges and Safety Profile in Patients Undergoing Endoscopic Retrograde Cholangiopancreatography

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KEYWORDS

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ABSTRACT:

Background: Endoscopic Retrograde Cholangiopancreatography (ERCP) is a technically demanding procedure requiring optimal sedation and vigilant anesthetic management, especially in patients with comorbidities. The aim of this study was to assess anesthetic challenges and safety outcomes associated with ERCP under Total Intravenous Anesthesia (TIVA).

Methods: This retrospective observational study was conducted over 12 months from January to December 2024 at Popular Diagnostic Centre Ltd and Popular Medical College Hospital, Dhaka, Bangladesh. A total of 340 patients aged 20–79 years who underwent ERCP under monitored anesthesia care were included. Data on demographics, comorbidities, procedure type, anesthetic drugs and intra-procedural complications were analyzed using SPSS version 25.

Results: The mean age of the study population was 60 ± 8.4 years, with a female predominance (70.29%). Common comorbidities included hypertension (30.29%), diabetes mellitus (20.29%), bronchial asthma (15.29%) and liver disease (10.29%). All procedures were conducted using TIVA with propofol, midazolam, fentanyl and ketamine. The average duration was 36.2 ± 6.9 minutes. Plastic stent placement and pancreatic procedures were each performed in 14.71% of cases, while metal stents were used in 6.18%. Anesthetic complications included desaturation (20%), hypotension (4.12%), airway obstruction (2.94%) and one procedure-related death (0.29%). Most adverse events were managed conservatively without conversion to general anesthesia.

Conclusion: ERCP under TIVA is generally safe when conducted with experienced personnel and vigilant monitoring. However, a proactive approach to managing respiratory and hemodynamic complications is essential to optimize outcomes.

Introduction

Endoscopic Retrograde Cholangiopancreatography (ERCP) is a complex and specialized endoscopic

procedure used primarily for the diagnosis and management of hepatobiliary and pancreatic disorders, such as choledocholithiasis, gallbladder and biliary



malignancy, chronic pancreatitis, and post-operative biliary leakage [1]. Over the years, the indications for ERCP have shifted predominantly toward therapeutic interventions rather than diagnostic purposes due to advances in non-invasive imaging like MRCP and endoscopic ultrasound (EUS) [2].

ERCP procedures are often technically demanding, requiring prolonged endoscopy time, prone or semi-prone positioning and occasionally involve critically ill patients [3]. These characteristics make anesthesia management particularly challenging. Unlike other gastrointestinal endoscopic procedures, ERCP often necessitates a deeper level of sedation or general anesthesia due to the need for immobility, airway control and patient tolerance [4]. Anesthetic agents must be titrated precisely to achieve adequate sedation while maintaining spontaneous respiration, airway protection and hemodynamic stability [5].

The use of Total Intravenous Anesthesia (TIVA), particularly with agents such as propofol, midazolam, fentanyl and ketamine, has become increasingly popular in ERCP because of their rapid onset, short duration of action and favorable recovery profiles [6]. However, the use of deep sedation or TIVA introduces its own set of risks, such as respiratory depression, desaturation, hypotension and airway obstruction, especially in patients with underlying comorbidities like diabetes, hypertension, bronchial asthma, or liver disease [7].

In Bangladesh and other resource-limited settings, anesthetic practices during ERCP vary widely based on institutional protocols, availability of skilled personnel and patient factors [8, 9]. Despite the growing number of ERCP procedures performed nationwide, there is limited published data from Bangladesh assessing the safety and anesthetic challenges associated with these procedures [10]. Understanding the profile of complications, identifying high-risk patients and evaluating the safety of sedation techniques are crucial for improving outcomes and ensuring procedural success [11].

This study was undertaken to evaluate the anesthetic challenges and safety profile in patients undergoing ERCP. By analyzing the frequency and nature of intra-procedural complications, the study aimed to provide

insight into current anesthetic practices, inform guidelines and promote safer peri-procedural care. The findings are expected to be useful for anesthesiologists, gastroenterologists and healthcare policymakers to enhance patient safety and procedural efficiency in ERCP services.

Methodology & Materials

This retrospective observational study was conducted at Popular Diagnostic Centre Ltd and Popular Medical College Hospital, Dhaka, Bangladesh, over a 12-month period from January 2024 to December 2024. A total of 340 patients who underwent Endoscopic Retrograde Cholangiopancreatography (ERCP) under monitored anesthesia care were included in the analysis. The primary objective was to evaluate anesthetic challenges and the safety profile associated with the procedure.

Patients aged between 20 and 79 years who underwent ERCP for diagnostic or therapeutic purposes were included in the study. Exclusion criteria were extremes of age (<20 years or >79 years), patients with incomplete records, emergency ERCP procedures and those with American Society of Anesthesiologists (ASA) physical status grade III or above.

All patients received Total Intravenous Anesthesia (TIVA) using propofol, midazolam, fentanyl and ketamine as per procedural need and anesthesiologist discretion. Standard monitoring included electrocardiogram (ECG), pulse oximetry, non-invasive blood pressure and capnography. Oxygen supplementation was provided via nasal cannula. Sedation levels were titrated to achieve optimal procedural conditions while maintaining spontaneous respiration. The average duration of ERCP was 36.2 ± 6.9 minutes, with a range of 20 minutes to 2 hours.

Data regarding patient demographics, indications for ERCP, comorbid conditions, types of interventions (e.g., metal stenting, plastic stent insertion, pancreatic procedures), anesthetic drugs used, intra-procedural events and complications such as desaturation, hypotension, airway obstruction, or mortality were collected from medical records and anesthesia charts. All collected data were entered into a predesigned datasheet and subsequently analyzed using Statistical Package for Social Sciences (SPSS) version 25.



Descriptive statistics such as frequency, percentage, mean and standard deviation were used to present quantitative and categorical variables.

Results

Table 1: Age Distribution of our Study Population (N = 340)

Age Group	Frequency (n)	Percentage (%)
Below 30 years	40	11.76
31–40 years	57	16.76
41–50 years	61	17.94
51–60 years	93	27.35
61–70 years	63	18.53
Above 70 years	26	7.65
Total	340	100

Table 1 presents the age distribution of the 340 patients who underwent ERCP during the study period. The majority of participants were in the 51–60 years age group, accounting for 27.35% (n = 93) of the total population. This was followed by the 61–70 years group with 18.53% (n = 63) and the 41–50 years group with 17.94% (n = 61). Patients aged 31–40 years made up 16.76% (n = 57), while those below 30 years comprised 11.76% (n = 40). The least represented group was those aged above 70 years, constituting 7.65% (n = 26). These findings indicate that the majority of ERCP procedures were performed in middle-aged to older adults.

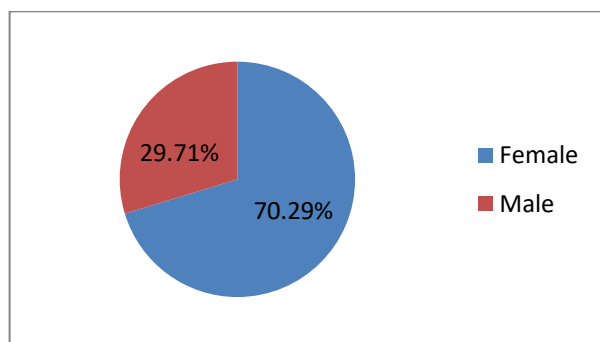


Figure 1: Gender Distribution of our Study Population (N = 340)

Figure 1 illustrates the gender distribution of the study population. Out of 340 patients who underwent ERCP, 239 were female (70.29%) and 101 were male (29.71%). This indicates a marked female predominance, with a female-to-male ratio of approximately 2.4:1.

Table 2: Comorbidities

Comorbidity	Frequency (n)	Percentage (%)
Diabetes Mellitus	69	20.29
Hypertension	103	30.29
Bronchial Asthma	52	15.29
Liver Disease (Cirrhosis/Fatty liver)	35	10.29

Table 2 outlines the distribution of comorbidities among the study participants. Hypertension was the most common comorbidity, present in 30.29% (n = 103) of patients, followed by Diabetes Mellitus, which affected 20.29% (n = 69). Bronchial Asthma was noted in 15.29% (n = 52) of the population, while liver diseases such as cirrhosis or fatty liver were present in 10.29% (n = 35).

Table 3: Type of ERCP Procedures

Procedure Type	Frequency (n)	Percentage (%)
Plastic Stent Placement (removed later on)	50	14.71
Metal Stent Placement	21	6.18
Pancreatic Stenting and Stone Extraction	50	14.71
Common Bile Duct (CBD) Stone Extraction	180	52.94
Papillotomy (Papillary Stenosis)	30	8.82
Extraction of Ascaris from CBD	9	2.65
Total	340	100

Table 3 summarizes the distribution of ERCP procedures performed among the 340 study participants. The most commonly performed intervention was



Common Bile Duct (CBD) stone extraction, accounting for 52.94% (n = 180) of all cases. Plastic stent placement, which was subsequently removed, and pancreatic stenting with stone extraction were each performed in 14.71% (n = 50) of patients. Papillotomy for papillary stenosis was conducted in 8.82% (n = 30), while metal stent placement was done in 6.18% (n = 21). A small proportion of patients, 2.65% (n = 9), underwent extraction of *Ascaris* from the CBD. These findings reflect the diverse therapeutic scope of ERCP, with a predominance of biliary stone management.

Table 4: Anesthetic Challenges and Safety Outcomes

Complication/Challenge	Frequency (n)	Percentage (%)
Desaturation	68	20.00
Hypotension	14	4.12
Airway Obstruction	10	2.94
Death (Procedure-related)	1	0.29

Table 4 highlights the anesthetic challenges and safety outcomes observed during ERCP procedures. The most frequently encountered complication was desaturation, affecting 20% (n = 68) of patients, underscoring the respiratory risks associated with sedation in prone or semi-prone positions. Hypotension was noted in 4.12% (n = 14), while airway obstruction occurred in 2.94% (n = 10) of cases. There was one procedure-related death (0.29%), attributed to severe underlying pancreatitis with septic complications.

Discussion

This study evaluated the anesthetic challenges and safety outcomes in 340 patients undergoing ERCP at a tertiary care center in Dhaka, Bangladesh. The findings revealed that while ERCP can be performed safely with Total Intravenous Anesthesia (TIVA), notable anesthetic risks such as desaturation (20%), hypotension (4.1%) and airway obstruction (2.9%) remain present. These observations are consistent with global literature emphasizing the complexity of sedation during ERCP due to the prone or semi-prone positioning, procedure duration and frequent comorbidities in the patient population.

Propofol-based sedation, combined with agents such as midazolam, fentanyl and ketamine, was employed in all cases in this study. This approach aligns with the growing trend of using propofol for ERCP due to its rapid onset and recovery profile. Zhang et al., found propofol-based sedation to be highly effective in maintaining procedural comfort and reducing recovery time compared to conventional sedation regimens [12]. Similarly, Zhou et al., compared remimazolam and propofol and concluded that both agents were safe, but propofol offered superior sedation depth and procedural control [13].

The complication rate observed in our study is consistent with that of other large-scale analyses. McCarty et al., conducted a meta-analysis and reported a pooled sedation-related complication rate of approximately 9–20%, with desaturation being the most frequent event [14]. Our desaturation rate of 20% falls at the higher end of this spectrum potentially reflecting variations in monitoring standards, patient comorbidities, or prolonged procedure times. Moreover, Sethi et al., reported similar findings in their randomized trial comparing midazolam and dexmedetomidine, emphasizing the importance of drug choice and monitoring in minimizing respiratory events [15].

Elderly patients pose an additional anesthetic challenge during ERCP. Khan et al., found that advanced age significantly increases the risk of sedation-related complications, particularly in patients with hypertension, diabetes, or liver disease [16]. In our study, over 25% of patients were aged 61 years or older and nearly one-third had hypertension, further substantiating the need for individualized risk assessment. Akhter et al., also observed that patients sedated under anesthesia assistance rather than conscious sedation experienced better procedural success and fewer interruptions, especially in elderly and high-risk groups [17].

The safety of performing ERCP in outpatient or day-care settings has also been evaluated in recent literature. Yadav et al., demonstrated that therapeutic ERCP is feasible and safe even in the "oldest old" patients when performed with adequate sedation and monitoring [18]. Our single mortality (0.29%) was related to severe



pancreatitis with sepsis and not directly linked to the anesthetic approach, reinforcing the procedure's overall safety when complications are appropriately managed.

Bhiuyan et al., highlighted that ERCP findings often differ significantly from preoperative imaging like ultrasound, necessitating therapeutic flexibility and potentially prolonging procedure time [19]. This variability can influence anesthetic depth and duration, as seen in our study, where the average procedure time was approximately 36 minutes but ranged from 20 minutes to 2 hours.

The debate on airway management during ERCP—whether to use endotracheal intubation or not—remains unresolved. Zhang et al., in their meta-analysis, suggested that while intubation provides airway security, especially in high-risk or lengthy procedures, it may not be necessary for all patients and could increase resource utilization [20]. In our study, none of the patients required conversion to general anesthesia with intubation, indicating that careful sedation and vigilant monitoring can be sufficient in most cases.

Lapidus et al., supported endoscopist-directed balanced propofol sedation, showing low complication rates and high procedural success, particularly when performed by experienced teams with appropriate monitoring [21]. This aligns with our practice, where anesthetic administration was handled by trained personnel with continuous monitoring.

Finally, Rustagi and Jamidar emphasized that adverse events in ERCP are often multifactorial, involving both procedural and sedation-related risks [22]. Our findings corroborate this, as the complication rates were mostly manageable and associated with modifiable factors such as drug titration and comorbidity control.

The present study contributes to the regional data on ERCP by highlighting that with appropriate TIVA protocols, careful patient selection and vigilant intra-procedural monitoring, ERCP can be performed safely even in high-risk patients. However, individualized anesthetic strategies, especially in older adults and those with comorbidities, remain essential to minimizing adverse events and improving overall procedural outcomes.

Limitations of the study

This study was retrospective in nature, which may introduce selection and documentation bias. It was conducted at only one center, limiting generalizability to other healthcare settings. Additionally, detailed intra-procedural monitoring data such as sedation scores or capnography trends were not uniformly available and post-ERCP outcomes were not assessed.

Recommendations

Future studies should adopt a prospective, multicenter design with standardized sedation protocols to better evaluate anesthetic safety. Incorporating objective sedation scales, capnography and real-time adverse event tracking can improve understanding of risk profiles. Training programs on airway management and sedation strategies tailored for ERCP should be emphasized, particularly in resource-limited settings.

Conclusion

ERCP is a safe and effective procedure when conducted under Total Intravenous Anesthesia with vigilant monitoring. While complications such as desaturation and hypotension are not uncommon, most can be managed without escalation to general anesthesia. Proper patient selection, experienced anesthetic teams and individualized sedation approaches are key to optimizing safety and outcomes.

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Conflicts of interest

There are no conflicts of interest.

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