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Incidence and Risk Factors of Significant Unplanned Events During Anaesthesia-Assisted Gastrointestinal Endoscopy: A Prospective Observational Study

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Abstract

Introduction: Gastrointestinal (GI) endoscopy is essential for managing various GI conditions, particularly in critically ill patients. These procedures, often performed under anaesthesia, carry risks of significant unplanned events (SUEs), which can impact patient safety. This study assessed the incidence and risk factors of SUEs during anaesthesia-assisted GI endoscopy. ***Materials and Methods:*** A prospective observational study was conducted in a tertiary care center involving 170 adult patients undergoing elective or emergency GI endoscopy under anaesthesia. Demographic, clinical, and procedural data were collected using standardized forms. SUEs included airway obstruction, hypoxia, hypotension, bradycardia, and cardiac arrest. Statistical analyses were performed using SPSS v23 with $p<0.05$ as the threshold for significance. ***Results:*** Of 170 patients, 54.7% were male; the mean age was 43.3±16.7 years. Most were ASA Grade I or II. TIVA was the most common anaesthetic technique (57.6%). The overall SUE incidence was 9%, with hypoxia and hypotension each in 2.4%, bradycardia and airway obstruction in 1.8%, and cardiac arrest in 0.6%. Higher ASA grades, poor general condition, and CNS or respiratory findings were associated with more events. ***Conclusion:*** Though generally safe, GI endoscopy under anaesthesia can result in SUEs. Comprehensive monitoring, risk assessment, and standardised protocols are crucial to enhancing patient safety and outcomes.

Keywords: ***Endoscopy, Gastrointestinal, Anaesthesia, Conscious Sedation, Adverse Events, Risk Assessment, Airway Obstruction.***

Introduction

The physician's primary role is to identify and treat abnormalities and deficiencies in human function, a task that has evolved significantly with advancements in medical technology. Endoscopy has revolutionized the diagnosis and management of various gastrointestinal (GI) pathologies. Endoscopy allows for the minimally invasive evaluation and treatment of internal structures and is now a cornerstone of gastroenterological practice, particularly within tertiary care settings. The increasing complexity of cases, including critically ill patients who might otherwise require high-risk surgery, has led to a growing reliance on endoscopic interventions. These procedures, often technically challenging and uncomfortable, are commonly performed under sedation or anaesthesia to reduce patient discomfort and improve procedural success. Gastrointestinal endoscopy has thus become the most frequently performed procedure under sedation. Historically, sedation was administered by the endoscopist, but anaesthesia professionals are now increasingly involved, especially in university hospitals where dedicated endoscopy suites present unique logistical and operational challenges.

Despite its widespread use and perceived safety, gastrointestinal endoscopy is still associated with a consistent rate of complications, often linked to equipment failure, patient comorbidities, or anaesthetic interactions. Recognizing patients' risk profiles and monitoring for intraoperative events are crucial for improving safety. Significant unplanned events-defined as deviations from optimal care with the potential to cause harm-serve as critical indicators of system vulnerability. Incident reporting, first formalized by Flanagan in aviation and later adapted for medical use by Cooper *et al*., plays a vital role in identifying such events and

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guiding quality improvement. A functional reporting system must not only detect hazards but also lead to actionable recommendations for systemic change.

This study aims to determine the incidence of significant unplanned events and their associated risk factors in adult patients undergoing gastrointestinal endoscopic procedures under anaesthesia. The primary objective is to assess the frequency of these events, while the secondary objectives are to evaluate patient risk profiles and explore correlations between these profiles and the occurrence of significant unplanned events, thereby contributing to patient safety and improved clinical outcomes.

Materials and Methods

This prospective observational study aimed to assess the incidence and risk factors of significant unplanned events in adult patients undergoing gastrointestinal endoscopic procedures under anaesthesia care. Conducted in the endoscopy suite of a tertiary care center, data were recorded using standardized case record forms attached to the anaesthesia register. Information was collected by the principal investigator, co-investigator, and attending anaesthesia team during routine clinical care.

All patients aged 18 years and above undergoing emergency or elective gastrointestinal endoscopic procedures were included. Each procedural session was considered one case, while repeated procedures in different sessions for the same patient were treated as separate cases. Pregnant and lactating women were excluded.

Collected data included patient demographics (age, sex, BMI), ASA status, comorbidities, and ongoing medications. Anaesthesia-related parameters-type of anaesthetic care (monitored anaesthesia care, sedation, TIVA, or general anaesthesia), airway management, anaesthesia duration, oxygen supplementation, fluid and drug administration, and post-procedure ICU requirement-were noted. Procedural data included the type and purpose of the endoscopy (diagnostic, therapeutic, or palliative), anatomical site (upper or lower GI), and duration.

Significant unplanned events were defined as deviations from optimal care requiring clinical intervention. These included Airway obstruction, Hypoxia, Hypotension, Bradycardia and Cardiac arrest. Data were entered in Microsoft Excel and analyzed using SPSS version 23. Quantitative variables were summarized using mean, standard deviation, median, and IQR. Categorical variables were presented as frequencies and percentages. Associations were assessed using Chi-square or Fisher's Exact tests, and continuous variables were compared using unpaired t-tests or non-parametric alternatives depending on normality (Shapiro-Wilk test). Statistical significance was set at $p<0.05$.

Based on an expected unplanned event rate of 6.2% (Leslie *et al*.), [1] a minimum sample size of 154 was calculated using a 1% type I error and 5% absolute precision. Accounting for 10% attrition, the final sample size was set at 170.

Results

Out of a total of 170 patients, 93 (54.7%) were male, while 77 (45.3%) were female, indicating a slight predominance of male patients. Out of a total of 170 patients, 33 (20.0%) were of >60 years of age, while 77 (45.3%) were <40 years of age, 60 (35%) were of 41-60 years of age and Mean Age was 43.3±16.7 years, indicating a slight predominance of middle age patients. The most common diagnosis was choledocolithiasis, with 30 cases (17.6%), followed by CBD stricture, accounting for 22 cases (12.9%). Other prevalent diagnoses include obstructive jaundice (17 cases, 10.0%) and dysphagia (16 cases, 9.4%). Achalasia was observed in 11 patients (6.5%), GERD in 14 patients (8.2%), and pancreatic pseudocyst in 9 patients (5.3%). Less frequent conditions such as adenomatous polyps, anemia, gastric cancer, and several others were each found in only one patient (0.6%). The least common diagnosis was accidental ingestion of a ring, also seen in just one patient (0.6%). The distribution of various diagnoses is given in **Table 1**. The majority, 110 patients (64.7%), had no comorbid conditions. Among those with comorbidities, diabetes mellitus (DM) was the most common, present in 26 patients (15.3%), followed by hypertension (HTN) in 23 patients (13.5%). Six patients (3.5%) had both DM and HTN, while other comorbidities like aortic aneurysm and obstructive sleep apnea (OSA) were rare, each affecting only one patient (0.6%). A substantial portion, 121 patients (71.2%), had no notable past history. UGI endoscopy had been performed previously in 22 patients (12.9%), making it the most common past procedure. ERCP (Endoscopic Retrograde Cholangiopancreatography) had been done in 8 patients (4.7%), and ERCP with stenting in 5 patients (2.9%). Rare interventions, such as cholecystectomy, ascitic tapping, and gastrotomy, were reported in only one patient each (0.6%). more than half of the patients (95 patients, 55.9%) had no history of addictions. Among those with addiction histories, tobacco use was the most common, with 46 patients (27.1%) reporting tobacco consumption. Alcohol use alone was reported by 5 patients (2.9%), while combined use of alcohol, smoking, and tobacco was seen in 12 patients (7.1%). Smoking alone and combined tobacco and smoking habits were less frequent, seen in only 3 patients (1.8%) and 7 patients (4.1%), respectively. The vast majority, 159 patients (93.5%), were in fair condition at the time of endoscopy, while 7 patients (4.1%) were classified as moderate, and only 4 patients (2.4%) were in poor condition. Nearly all patients (166, or 97.6%) were conscious. One patient (0.6%) was agitated, 1 (0.6%) was disoriented, and 2 patients (1.2%) were unconscious at the time of the endoscopy. A total of 166 patients (97.6%) had clear breath sounds with equal air entry bilaterally, while 1 patient (0.6%) had reduced air entry at the basal region and 3 patients (1.8%) had basal crepitations. Most patients (156, or 91.8%) had results within normal limits (WNL). Bronchovascular markings (BVM) were found in 14 patients (8.2%). Normal sinus rhythm (NSR) was noted in 161 patients (94.7%). Sinus tachycardia was observed in 3 patients (1.8%), while left ventricular hypertrophy (LVH) was present in 6 patients (3.5%). Most patients were classified as ASA Grade II (90 patients, 52.9%), followed by ASA Grade I (65 patients, 38.2%). Higher-risk patients were less common, with 8 patients (4.7%) in Grade III and 7 patients (4.1%) in Grade IV. Among the 170 patients, UGI scopy was the most common procedure, accounting for 31 patients or 18.2% of the total. Other frequently performed procedures included ERCP with stenting in 19 patients (11.2%) and ERCP in 17 patients (10.0%). Several procedures had a lower frequency, such as colonoscopy (10.0%), ERCP with stent exchange (5.9%), and POEM (6.5%). Some of the least common procedures included antireflux mucosal ablation, and cholangioscopy, which were rare. This distribution reflects the diversity of surgical interventions required for patients undergoing gastrointestinal endoscopy, with a notable prevalence of UGI and ERCP-related procedures. The most common form of anaesthesia was TIVA (Total Intravenous Anaesthesia), used in 98 patients (57.6%). General anaesthesia (GA) was administered to 55 patients (32.4%), and Monitored Anaesthesia Care (MAC) was used in 16 patients (9.4%). One patient (0.6%) who initially received TIVA required conversion to GA. The dominance of TIVA suggests its widespread use during endoscopic procedures in this cohort. Ringer's Lactate (RL) was administered to nearly all patients, with 168 patients (98.8%)

receiving it. Only 2 patients (1.2%) were given both RL and packed cell volume (PCV). The near-universal use of RL underscores its role as the fluid of choice during gastrointestinal endoscopy. Out of 170 patients, 167 (98.2%) experienced no airway obstruction. There were rare occurrences of NP to ETT conversion (0.6%), positive pressure ventilation (PPV), and tracheal suctioning (each 0.6%). The low incidence of airway obstruction highlights the safety of airway management during these procedures. Most patients (166, 97.6%) experienced no hypoxia, with only 4 patients (2.4%) reporting hypoxia during the procedure. The data indicates a low incidence of respiratory complications in this cohort. Similar to hypoxia, the majority of patients (166, 97.6%) did not experience hypotension. Hypotension was observed in only 4 patients (2.4%), suggesting minimal cardiovascular complications during endoscopic procedures. Bradycardia occurred in 3 patients (1.8%), while the vast majority (167 patients, 98.2%) had no such issues. This low incidence of bradycardia is consistent with the overall safety profile seen in the anaesthesia management of these patients. One patient (0.6%) experienced cardiac arrest and received cardiopulmonary resuscitation (CPR). The overwhelming majority (169 patients, 99.4%) did not experience cardiac arrest, again highlighting the general safety of the procedures performed. Airway obstruction was more frequent in patients younger than 40 years (2.6%), while hypoxia was also more common in this group (3.9%). However, no statistically significant associations were found between age groups and the incidence of unplanned events.

Table 1: Distribution of various diagnoses in the studied population

Diagnosis	Frequency	Percentage
Choledocolithiasis	30	17.60%
CBD Stricture	22	12.90%
Obstructive jaundice	17	10.00%
Dysphagia	16	9.40%
GERD	14	8.20%
Achalasia cardia	11	6.50%
Pancreatic Pseudocyst	9	5.30%
Oesophageal stricture	4	2.40%
PUD	4	2.40%
Colonic Stricture	3	1.80%
Constipation	5	3.00%
Oesophageal Carcinoma	3	1.80%
IBS	3	1.80%
Liver cirrhosis	3	1.80%
Chronic Pancreatitis	2	1.20%
Haematemesis	2	1.20%
Malena	2	1.20%
Portal hypertension	2	1.20%
Adenomatous Polyps, Anaemia, Chronic Anemia, Colon polyp, Colon screening, Diarrhoea, Gastric Carcinoma, Gastric, Perforation, Lower Oesophageal stricture, Lower GI bleed, Obstruction, Oesophageal stricture, Pancreatitis, Polyp Screening, Polypectomy, PR Bleed, rectal mass, Accidental ingestion of ring	1 each	0.60%
Total	170	100.00%

Discussion

Endoscopy has become a pivotal tool in managing gastrointestinal conditions, especially in critically ill patients where it offers a safer alternative to high-risk surgical procedures. When performed under anaesthesia, it improves patient comfort but also poses the risk of significant unplanned events (SUEs). In this prospective audit of 170 adult patients, we assessed the incidence and associated factors for such events during gastrointestinal endoscopy under anaesthesia. The incidence of SUEs was 9%, comparable to 23% reported by Leslie *et al*., with specific rates of hypoxia (2.4%), hypotension (2.4%), bradycardia (1.8%), airway obstruction (1.8%), and cardiac arrest (0.6%), closely mirroring those in prior literature [1]. A male predominance was noted (54.7%), consistent with studies by Leslie (52%) and Saurabh *et al*. (61.8%) [1, 2]. The median age in our cohort was 43.3 years, lower than that in Leslie's (60 years) and Saurabh's (47.6–52.1 years) work [1, 2]. Comorbidities like diabetes mellitus (15.3%) and hypertension (13.5%) were prevalent and in line with rates in other studies [1, 2]. We observed that poor general condition and prior surgical history were significantly associated with hypotension, requiring IV fluid and vasopressor support. Hypotension was statistically linked with basal crepitations (p=0.002), as was cardiac arrest (p=0.024). CNS findings like disorientation or unconsciousness were associated with airway obstruction (p=0.035) and hypoxia (p=0.047). Airway obstruction (1.8%) was effectively managed with maneuvers and positive pressure ventilation. Liesle *et al*. reported a slightly higher airway obstruction rate (2.1%) [1]. Hypoxia, also seen in 2.4% of our cases, was lower than the 11% reported by Saurabh *et al*., and similar to Liesle's 2% rate [2, 1]. Our management included jaw thrusts and, in one case, endotracheal intubation.

ERCP procedures were most commonly linked with SUEs-66.7% of airway obstruction, 75% of hypoxia, and 100% of cardiac arrests were associated with ERCP, although the results were not statistically significant. These findings are reinforced by Saurabh *et al*. who also observed a high incidence of SUEs with ERCP procedures [2]. Bradycardia, noted in 1.8% of patients, was managed with supportive therapy including atropine and oxygen. Cardiac arrest occurred once (0.6%), matching Leslie's reported rate [1]. ASA classification was a strong predictor of complications. All SUEs were more common in ASA Grade IV patients. Leslie *et al*. also observed higher ASA grades correlating with higher risk of peri-procedural adverse events [1]. This emphasizes the need for detailed pre-anaesthesia evaluations, particularly in patients with CNS, respiratory, or cardiovascular abnormalities.

TIVA was the most commonly used anaesthetic technique (57.6%), followed by GA (32.4%) and MAC (9.4%). While capnography is a useful tool in detecting early hypoventilation, it was not consistently used in our study, potentially delaying detection. Goudra *et al*. have highlighted the role of capnography in improving safety during GI procedures [3]. The study underscores the need for strict monitoring protocols, comprehensive preoperative assessments, and the implementation of standardized documentation and feedback systems. Developing endoscopy-specific anaesthesia guidelines and encouraging incident reporting can enhance patient safety and reduce the occurrence of avoidable events.

Conclusion

This study provides a comprehensive evaluation of the incidence and risk factors associated with significant unplanned events during gastrointestinal endoscopic procedures performed under anaesthesia care. The incidence of such events was observed to be 9%, with hypoxia, hypotension, and bradycardia emerging as the most common complications. These findings underscore the inherent risks of anaesthesia-assisted endoscopy, particularly in patients with pre-existing comorbidities such as cardiovascular, respiratory, or metabolic disorders. The results emphasize the critical importance of preoperative risk stratification and thorough clinical evaluation, as a majority of patients belonged to ASA physical status I and II but still experienced adverse events, highlighting the pivotal role of individual clinical judgement.

Moreover, the study demonstrates that patient factors such as age, gender, comorbidity status, type of endoscopic procedure, and anaesthetic technique significantly influence outcomes. It further reinforces the need for vigilant intra-procedural monitoring and timely identification of physiological deterioration to prevent escalation of complications. Implementation of advanced monitoring protocols and evidence-based anaesthetic practices can enhance patient safety in this specialized setting. In light of the findings, there is a pressing need to establish structured feedback systems and standardized protocols to improve patient care, safety, and procedural outcomes. Strengthening these measures will not only reduce the incidence of unplanned events but also enhance the overall quality of anaesthesia services in gastrointestinal endoscopy suites.

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Human subjects

Consent for treatment and open access publication was obtained or waived by all participants in this study. Lokmanya Tilak Municipal Medical College and General Hospital issued approval IEC/DISS/118/19. The IEC-II hereby approves the proposal entitled Protocol version no. 1.2 "ACUTE CONFUSIONAL STATE IN ELDERLY: PROGNOSTIC FACTORS AND OUTCOME".

Animal subjects

All authors have confirmed that this study did not involve animal subjects or tissue.

Conflicts of interest

None

Payment/services info

Financial relationships

All authors have declared that they have no financial relationships at present or within the previous three years 9 of 10 with any organizations that might have an interest in the submitted work.

Other relationships

All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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