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Anaesthesia Concerns for Gastrointestinal Endoscopic Procedures

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ABSTRACT

Endoscopic retrograde cholangiopancreatography (ERCP) is a unique diagnostic and therapeutic procedure performed in high-risk patients in prone/semi-prone positions. ERCP has evolved from a simple diagnostic procedure performed under endoscopist-administered sedation to a therapeutic one involving increasingly complex techniques. The anaesthesiologist has become a vital member of the team. Complex interventional gastrointestinal endoscopy procedures are challenging due to high-risk patient profiles, non-operating room set-up, non-supine position, space restrictions, prolonged duration, and airway sharing-related issues. These procedures require deep sedation or general anaesthesia to be administered to the patient, and vigilant airway management is of utmost importance. However, there is a significant lack of literature on recommendations regarding specific anaesthesia techniques. This gap in knowledge can have implications for patient safety and procedural ease. Therefore, it is crucial to increase awareness of anaesthetic concerns for these challenging non-operating room procedures, allowing the anaesthetist to select an appropriate technique to provide safe and effective anaesthesia and optimise patient outcomes. Our objective is to delve into the various anaesthesia techniques utilised and review the unique challenges these procedures pose in remote anaesthesia settings.

Keywords: Anaesthesia; anaesthesia safety in endoscopic procedures; conscious sedation; developing nations; gastrointestinal endoscopy.

INTRODUCTION

Endoscopic gastrointestinal procedures have become extremely common and complex with the advancement of technology. The complexity of procedures results in possible complications and adverse events. While simple procedures and diagnostic endoscopies are usually done without the assistance of specialist anaesthetists, there is a consensus that the anaesthetic drugs with dosages are best judged by a dedicated specialist who can devote whole attention to the effect of the drugs and the patient's clinical condition. The integration of anaesthesia services into endoscopy services has resulted in the possibility of the performance of complex endoscopic procedures, especially in high-risk patients. This integration has been driven by various factors, including the endoscopists performing complicated endoscopy procedures, the preference for optimal operating conditions with undivided attention, the patient profile dictating administration of sedation and general anaesthesia specifically to the patients of paediatric age group, and the availability of short-acting agents such as propofol which offers optimal operating conditions with complete recovery leading to the possibility of day-care treatment, patient and endoscopist satisfaction. These factors have led to an increasing utilisation of anaesthesia services around the globe.

METHODS

Search Strategy and Selection Criteria: To identify articles, key questions were formulated to construct an analytic framework and were searched through PubMed, Embase, and Google Scholar to find relevant articles and identify pertinent literature. This was a qualitative non-meta-analysis narrative review. A comprehensive literature search was conducted with inclusion criteria related to anaesthesia management for patients undergoing endoscopy specifically oriented towards the present status, pre-anaesthetic evaluation concerns, various anaesthesia techniques, safety, ethical issues and financial concerns about the presence or absence of an anesthesiologist. Key words searched

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included 'gastrointestinal' 'endoscopy', 'endoscopic retrograde cholangiopancreatography', 'anaesthesia', 'monitored anaesthesia care', 'conscious sedation', and a combination of these using Boolean operators 'and', 'or', 'not'. Over 250 reviews and original papers were identified. Of these, 40 studies which supported the aims were used for information extraction following the inclusion and exclusion criteria. The bibliographies of these articles were also used for additional information searches.

Studies that were chosen to be included were in the English language. Articles had to be related to gastrointestinal endoscopy. All ages, genders and ethnicities were targeted for this review and included in the search. The study design included in the review were case-control studies, case studies, case reviews, guidelines, systematic reviews and meta-analyses.

Studies in languages other than English were excluded. Any literature without full text was excluded.

DISCUSSION

Diagnostic and intervention endoscopy procedures have undergone significant advancements in recent years regarding the scope and complexity of the procedures performed and the patient profiles listed. Tables 1 and 2 summarise standard endoscopic procedures with anaesthesia concerns in adults and children.

Table 1. Common Adult endoscopic interventions.

Diagnosis	Procedure	Anesthesia concerns	Anesthesia techniques
Evaluation of- Dysphagia/ odynophagia, Reflux or heartburn symptoms, abdominal pain and dyspepsia, unexplained nausea, vomiting, weight loss, anaemia, diarrhoea, constipation, bleeding, stricture, ulcer, haemorrhoids, diverticula etc	• Diagnostic EGD • Diagnostic sigmoidoscopy • Diagnostic lower endoscopic ultrasound	Outpatient procedure	• Usually done with analgesia and monitored anaesthesia care (Mild to moderate sedation) • Consider intubation in patients with retention of gastric or oesophageal contents and gastrointestinal obstruction.
Advanced endoscopic interventions			
Choledocholithiasis, Benign biliary strictures Palliation of malignant biliary obstruction, Bile leak	Endoscopic Retrograde Cholangiopancreatography (ERCP)	• Endoscopy with fluoroscopy technique • Prolonged procedure time • These patients often are acutely or chronically ill and hospitalised with recent surgical history.	• Constraints for anaesthesia equipment and personnel. • Darkroom for fluoroscopy hampers monitoring • A prone position may be required • Consider general anaesthesia with endotracheal intubation in selective patients.

Table 1. Common Adult endoscopic interventions.

Diagnosis	Procedure	Anesthesia concerns	Anesthesia techniques
Epithelial-based neoplasms (Barrett'sesophagus)	• Endoscopic mucosal resection (EMR) techniques • Endoscopic submucosal dissection (ESD) (Advanced form of EMR for more extensive lesions) • Mucosal ablation therapy (Radiofrequency ablation (RFA))	• Requires precision and a quiet field. • Post-resection bleed	• Patients often need deep sedation to reduce motion. • General anaesthesia with endotracheal intubation in ESD • RFA may be done under MAC, and propofol is often preferred.
Obscure GI bleeding Capsule endoscopy or radiological abnormalities	Balloon-Assisted Deep Enteroscopy (BADENT)	• Long-duration procedure • Considerable discomfort during the procedure.	• Usually performed under MAC
Lesions in the upper gastrointestinal tract wall, mediastinal structures, pancreas, and surrounding peritoneal structures	Endoscopic ultrasound (EUS) for tissue characterisation and fine needle aspiration	• Larger outer diameter and longer fixed length of the endoscope tip results in patient discomfort.	• Deeper sedation compared to standard EGD.
Pancreatic pseudocyst	Natural Orifice Transluminal Endoscopic Surgery (NOTES) • Endoscopic cystogastrostomy • Per oral endoscopic myotomy (POEM)	• CO_2 insufflation may result in tension capnoperitoneum and capnothorax.	• Septic patients with pseudo pancreatic cysts may require GA with ETI rest may be managed with MAC • POEM is usually performed in a supine position under GA with ETI

Abbreviations-EGD: Esophagogastroduodenostomy; ERCP: Endoscopic Retrograde Cholangiopancreatography; EMR: Endoscopic mucosal resection; ESD: Endoscopic submucosal dissection; RFA: Radio frequency ablation; BADENT: Balloon-Assisted Deep Enteroscopy; MAC: Monitored anesthesia care; EUS: Endoscopic ultrasound; NOTES: Natural Orifice Transluminal Endoscopic Surgery; POEM: Per oral endoscopic myotomy; CO_2: Carbon dioxide; GA: General anaesthesia; ETI: Endotracheal intubation

Table 2. Common pediatric endoscopic interventions.

Diagnosis	Procedure	Comparison of sedation in the pediatric age group with general anaesthesia	Remarks/ anticipated complications

Enteral feeding and stomach decompression	Percutaneous Endoscopic Gastrostomy (PEG)	Sedation without securing airway-
		• Children are predisposed to airway obstruction and hypoxia
		• Reactive airway disease-
		  • Laryngospasm and bronchospasm
		• Increase airway resistance due to
		  • Small airway space
		  • Oedema, secretions, large tongue
		  • Tonsils and adenoid hypertrophy
		• Sedation titration is difficult in prolonged procedures.
		• Advantages in terms of-
		  • Maintenance of spontaneous ventilation
		  • Smooth emergence
		  • Saving time for intubation and extubation
		
		General anaesthesia-
		• Secured airway
		• Safer in patients with gastroesophageal reflux disease, protracted vomiting or suspected bowel obstruction.
			Aspiration pneumonia/ migration of gastrostomy tube

Swallowed foreign body	Endoscopy guided removal of foreign body.		10-20% of total foreign bodies impact the cervical oesophagus. More than 24 hours impacted foreign bodies removed by endoscopy. Battery foreign body should be removed as soon as possible.
Gastroesophageal varices	• Sclerotherapy • Endoscopic variceal ligation		Acute and chronic varices can be present in all age groups of children Variceal ligation devices may not be available in proper sizes for children.
Oesophageal stricture (post oesophageal atresia repair, post variceal sclerotherapy, post-radiation and caustic ingestion)	Endoscopic stricture Dilation		Balloon catheter technology with constant inflated pressure for around 3 minutes may result in complications such as bleeding and perforation of the oesophagus.
Juvenile Polyps	Endoscopic polypectomy		Post polypectomy haemorrhage, rarely intestinal perforation
Hepatobiliary and Pancreatic Disease	Endoscopic retrograde cholangiopancreatography (ERCP)		Few congenital biliary and pancreatic anomalies are treated during ERCP. Endoscopy with fluoroscopy
Eosinophilic Esophagitis	Endoscopic oesophageal evaluation of disease progress and response to therapy		• Food allergies (egg/ soy)- Contraindication to propofol
Post-small bowel transplant	Endoscopic evaluation of bowel		• Repeated evaluations • Stoma site evaluation may need minimal or no sedation. • Prolonged TPN may result in underlying coagulopathies

Abbreviations- PEG: Percutaneous Endoscopic Gastrostomy; ERCP: Endoscopic retrograde cholangiopancreatography

Patient evaluation and preparation are critical to safe and effective endoscopy with or without anaesthesia. As for any other surgical procedure, pre-procedure evaluation for an endoscopy procedure begins with detailed history taking, examination and investigations. This is followed by risk stratification and preparation. Medical history should focus on reviewing for the presence of critical systemic diseases such as cardiovascular, respiratory, neurologic, psychiatric, and renal. A complete airway examination must be carried out to anticipate any difficulty in airway management. In the case of systemic diseases, treatment must be reviewed and optimised with the help of a medical specialist if needed. A previous surgical history of the gastrointestinal tract might affect the endoscopic procedure, so it must be asked for. In addition, enquiring about drug allergies and substance abuse may alter the management of the patient during the procedure. There is no specific risk stratification for endoscopy under sedation to predict morbidity and mortality related to the procedure, and the American Society of Anesthesiologists (ASA) Physical Status Classification is widely utilised to risk stratify the patients posted for endoscopy.[1] A study involving a retrospective Clinical Outcome Research Initiative (CORI) database review analysed 324737 endoscopic procedures and found that during gastrointestinal endoscopy with conscious sedation, higher ASA grading was associated with excess unplanned cardiopulmonary events.[2]

The British Society of Gastroenterology (BSG) and the European Society of Gastrointestinal Endoscopy (ESGE) recommend managing patients on antithrombotic agents during endoscopy procedures.[3] For these patients, there is a risk of thrombosis upon stopping the therapy and a risk of bleeding upon continuing them. (Table1) For all endoscopies, aspirin is advised to be continued except for ampullectomy, considering the pros and cons of stopping aspirin. The guidelines recommend continuing P2Y12 receptor antagonists as solo therapy or in dual antiplatelet therapy (DAPT) in low-bleeding-risk endoscopic procedures. Also, warfarin may be continued with an international normalised ratio (INR) within the therapeutic range. Direct oral anticoagulants (DOACs) are suggested to be stopped on the morning of the procedure. For high-risk bleeding endoscopic procedures, discontinue P2Y12 receptor antagonists like clopidogrel and ticlopidine seven days before the procedure, whereas aspirin may be continued if the patient is on DAPT. The various low and high-risk bleeding endoscopy cases have been summed up in Table 3. For high bleeding-risk endoscopic procedures in low thrombotic-risk patients, warfarin is recommended to be discontinued for five days before the procedure (INR < 1.5 before the procedure). Whereas in high thrombotic risk, patients undergoing high bleeding risk endoscopic procedures must consult with an interventional cardiologist to discuss the risk/benefit of withholding P2Y12 receptor antagonists. For high thrombotic risk patients undergoing high bleeding risk endoscopic procedures, warfarin should be bridged over to low molecular weight heparin for the peri-procedure period.

Table 3: Bleeding risk of various gastrointestinal procedures

Low bleeding risk procedures	High bleeding risk procedures
Diagnostic endoscopy procedures with or without biopsy	Ampullectomy
Oesophageal, enteral, colonic, pancreatic or biliary stenting	ERCP with sphincterotomy
Enteroscopy without polypectomy	Endoscopic polypectomy, mucosal resection or submucosal dissection
Endoscopic ultrasound without intervention or sampling	Stricture dilatation in the upper or lower gastrointestinal tract
	Endoscopic variceal treatment
	Oesophageal or gastric radiofrequency ablation
	Percutaneous endoscopic gastrostomy
	Endoscopic ultrasound-guided sampling or interventional procedures

In addition to history and examination, the standards of practice committee of the American Society for Gastrointestinal Endoscopy (ASGE) 2014 has given recommendations regarding routine testing before endoscopic procedures.[4] These recommendations have been summarised in table 4.

Table 4: Preoperative testing in gastrointestinal endoscopy procedures

Laboratory investigation	Recommendation
Coagulation testing	• Routine preoperative coagulopathy screening (PT, INR, PTT, platelet count, and bleeding time, all alone or in combination) is not recommended in absence of clinical suspicion. • Can be done in patients with active bleeding, suspected bleeding disorder.
Chest radiography (CXR)	• Routine chest radiograph is not recommended before endoscopy • Consider CXR in patients with new respiratory signs, symptoms or decompensated cardiac failure.
Electrocardiography (ECG)	• An ECG is obtained for patients with comorbidities posted for complex procedures. • Routine ECG in patients posted for endoscopy is not recommended.
Blood typing and cross-matching	Not recommended routinely except for high bleeding risk and acute gastrointestinal bleeding.
Hemoglobin/hematocrit testing	Hemoglobin measurement is considered in patients with anemia or a high risk of bleeding.
Urinalysis	Not recommended routinely
Pregnancy testing	May be considered in women of childbearing age before endoscopy and fluoroscopy in uncertain pregnancy history.
Serum chemistry	Selective and individualized blood chemistry in patients with significant organ dysfunction.

Informed consent- This is a vital document which must not be neglected. American Society for Gastrointestinal Endoscopy (ASGE) has recommended guidelines on informed consent for GI endoscopic procedures.[5] It is recommended to include key information in informed consent such as a review of relevant medical summary, description of the diagnostic or therapeutic procedure to be performed, anticipated potential benefits of the procedure, potential adverse events and risks associated with the procedure, and discussion regarding the need of intubation, resuscitation, adverse events possibility during the anesthetic procedure, hospitalization and blood transfusion. In pediatric patients, age-appropriate consent and assent is recommended from the family and patients.

Fasting protocols- Gastrointestinal endoscopy is indicated in many medical conditions which make patients at risk of aspiration especially the patients undergoing sedation. There are no specifically designed guidelines for patients undergoing endoscopy with or without sedation. The American Society of Anesthesiologists guidelines indicates minimum fasting of 2 hours after ingestion of clear liquids and 6 hours after ingestion of light meals before proceeding for sedation for elective surgery.[6] The guidelines are based on gastric emptying time and should apply to the patients posted for elective endoscopy except for patients having organic lesions in the gastrointestinal tract hampering gastric emptying time.

Antibiotic prophylaxis and/or treatment to prevent local infections- The Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy (ASGE) have given a recommendation for antibiotic use in patients posted for endoscopy.[7] The antibiotics prophylaxis for infective endocarditis is not indicated for all cardiac conditions. It is indicated in cases with prosthetic cardiac valves, history of infective endocarditis, cardiac transplant with valvulopathy, patients with CHD, unrepaired cyanotic heart disease including palliative shunts and conduits, completely repaired CHD with prosthetic device for the first 6 months, repaired CHD with residual defect and cardiac conditions associated with the highest risk of adverse outcome from infective endocarditis.

Safety in the gastrointestinal endoscopy unit- The Guidelines for safety in the gastrointestinal endoscopy unit have been formulated by the American Society for Gastrointestinal Endoscopy.[8] These recommendations include designated personal movement flow for safe physical movements, equipment check for the endoscopy unit anaesthesia care, correct identification of the patient, procedure and checklist to check compliance to the world health organisation's surgical safety checklist adapted to local needs of the institution. There has to be an infection prevention and

post-procedure monitoring plan in place, and personal protective equipment guidance for the staff engaged in patient care.

Monitoring during endoscopy-As per ASA standards of basic monitoring, qualified anaesthesia personnel must be present for the conduct of all general, regional and monitored anaesthesia care.[9] Also, for all patients under anaesthetic care, the patient's oxygenation, ventilation, circulation and temperature shall be evaluated. The patients receiving sedation in the form of monitored anaesthesia care (MAC) or general anesthesia must be monitored for their cardio-respiratory parameters pre, intra and post-procedure.[10] Commonly used equipment are continuous pulse oximetry, continuous electrocardiography and intermittent fixed interval non-invasive blood pressure monitoring. With the increased integration of anaesthesia services into endoscopy procedures, a few additional monitors have become popular such as continuous capnography and depth of anaesthesia monitoring. End-tidal carbon dioxide ($EtCO_2$) monitoring has become an essential to monitor the rate and depth of respiration during sedation while using oxygen prongs even though the $EtCO_2$ value itself may not be reliable enough unless the airway has been secured. Depth of anaesthesia monitoring using the Bispectral index (BIS) or any other monitor should be a routine in these cases as over-sedation and under-sedation can both be dangerous.[11] Particularly, intraprocedural patient movement due to undersedation can lead to internal organ injury.[12] Dedicated personal to monitor the patient during the procedure can decrease many of the intra-procedure complications due to early detection and management.

Endoscopy procedure conduct overview-

Oxygen therapy and advanced mangement-

The procedures such as complex pancreatic and biliary interventions, endoscopic myotomy and cysto-gastrostomy require longer procedure time and require deep sedation or general anaesthesia. While deep sedation usually requires propofol sedation and oxygen with a standard cannula or recently, a high-flow nasal cannula, general anaesthesia requires securing the airway with one of the advanced airway devices such as an endotracheal tube or laryngeal mask airway device. The various techniques for airway management have been summarized in table 5. Use of a nasopharyngeal airway connected to a breathing circuit for oxygen supplementation during deep sedation was found to be very effective in a recent study.[13] Deeper levels of anaesthesia in absence of an advanced airway may leave the airway prone to aspiration of gastric contents together with hypoventilation leading to hypoxia. The endotracheal tube placement though is a safer approach due to the secure airway, which may significantly increase the recovery time causing delays in patient turnover. The Royal College of Anaesthetists endorsed a joint position statement stating patients with higher body mass index with increased risk of aspiration may be managed with endotracheal tube placement for safer conduct of anaesthesia.[14] The statement does not clearly mention the need for an advanced airway during the propofol-induced deep sedation but stresses better training, accessible anaesthetists and better coordination between the anaesthetists and endoscopists. A retrospective study of 2132 patients from Australia and New Zealand undergoing endoscopy found significant airway obstruction reported in around 2.1% and significant hypoxia incidence of around 2% of the study population.[15] A randomized study by Smith ZL et al, found significantly increased hypoxemia ($p<0.001$) in patients managed without securing an airway during propofol sedation when compared to general anesthesia with endotracheal intubation.[16]

The use of supraglottic airway devices have been described in the literature. A case series of 22 patients who described the use of the Gastro-Laryngeal Tube (G-LT) for interventional endoscopic biliopancreatic procedures and reported good endoscopic manoeuvrability with mild complications in six patients.[17] A study comparing Gastro- Laryngeal Tube and endotracheal tube in patients posted for endoscopic retrograde cholangiopancreatography showed lesser stress response compared to the latter device.[18]

A prospective observational study in 292 ASA physical status classification 1 and 2 patients found LMA®Gastro™ to be highly successful for upper gastrointestinal endoscopy with an excellent success rate for insertion rate.[19] Another study in high-risk patients with ASA physical status ≥3 posted for complex and prolonged gastrointestinal endoscopic procedures demonstrated its feasibility.[20] (Figure 1)

In a randomized study 200 children undergoing esophagogastroduodenoscopy(EGD) were randomized to the LMA® Gastro™ Airway or the Ambu® AuraOnce™ LMA, it was shown that LMA® Gastro™ Airway blunted the increase in intracuff pressure during EGD and slight ease of procedure compared to Ambu® AuraOnce™ LMA.[21]

Hypoxemia can occur in 26 to 85% of cases undergoing endoscopy.[22,23] This results from the combination of airway obstruction by the endoscope, anaesthesia-induced upper airway collapse, respiratory depression and lung compression because of intestinal gas insufflations. Patients with obstructive sleep apnoea syndrome, obesity, hypertension, diabetes, heart disease, age older than 60 year, or high American Society of Anesthesiologists (ASA) physical status class are particularly at risk of hypoxemia and potentially prone to hypoxemia-induced complications.[18] It has been a prevalent practice to supplement oxygen through nasal prongs and nasopharyngeal airways attached to the anaesthesia circuit and machine. A multicentre RCT in patients with moderate to high risk of hypoxemia undergoing gastrointestinal endoscopy under deep sedation, high flow nasal oxygen during the procedure has been shown to decrease the rate of desaturation as compared with standard oxygen therapy.[24]

Table 5. Airway management in endoscopy

Airway management	Technique/ devices	Indications	Advantages/ disadvantages
Secure airway with controlled ventilation	Endotracheal intubation	High aspiration risk (full stomach, variceal bleeding, intestinal obstruction) Deranged GCS (hepatic encephalopathy) Anticipated difficult airway Complex endoscopic procedures with prolonged duration of the procedure	**Advantages** Minimal aspiration risk Minimal interference with the endoscopy Avoids the risk of airway obstruction and hypoxia **Disadvantages** Difficult learning curve Laryngoscopy response Post-procedure hoarseness
Partially secured airway with spontaneous or assisted ventilation	Laryngeal mask airway [(LMA® Gastro™ Airway, Ambu® AuraOnce™, Gastro-Laryngeal Tube (G-LT), etc.]	Complex endoscopies with the need of deep sedation	**Advantages** Easy to insert No hoarseness **Disadvantages** Post-procedure sore throat Aspiration risk is higher than endotracheal tube Risk of dislodgement during the procedure Limitation in endoscopy scope movements.
Unsecure airway with spontaneous ventilation	Nasal cannula Nasopharyngeal airway connected to anesthesia circuit High Flow Nasal Cannula (HFNC) therapy Buccal oxygenation	Simple diagnostic and therapeutic endoscopy procedures requiring conscious sedation	**Advantages** No hoarseness or sore throat Easy application Laryngoscopy response avoided **Disadvantages** Aspiration risk Airway obstruction risk

General considerations and anaesthesia conduct-

The conduct of the endoscopy procedure may be done with or without anaesthesia (usually performed with topical local anaesthetic use). In patients where it is done under anaesthesia, it may be done under monitored anaesthesia care (minimal, moderate, or deep sedation) or general anaesthesia (Table 6). In selected patient, endoscopy may be possible to perform under topical anaesthesia where a small diameter endoscope (<6mm) is intended to use in young co-operative non-anxious patients.[25] The degree of sedation is explained in table 4. Minimal sedation is usually well managed by the endoscopist and is done for uncomplicated diagnostic procedures in patients with no significant medical conditions. Patients having significant medical conditions such as extremes of age, severe cardiac, pulmonary,

renal, hepatic, or other systemic diseases, drug abuse, and potentially difficult airway are usually preferred by the endoscopist for assistance from an anesthesiologist. Moderate to deep sedation is usually performed with benzodiazepines with opioids. Short-acting benzodiazepines are used for anxiolysis and sedation. Also, short-acting opioids such as fentanyl have a synergistic effect. Each patient has a different sensitivity to these agents and so the reversal agents to these agents (naloxone and flumazenil) must be available. Second-line agents such as droperidol must only be used when first-line agents do not provide adequate sedation keeping in mind the adverse effects and black box warnings from U.S. FDA.[26] Also, propofol has been frequently used for moderate sedation in endoscopy. The ASGE committee have provided guidelines for non-anaesthesiologist and anaesthesiologist administered propofol sedation. In both scenario it has been recommended that propofol should be administered by personnel trained in emergency airway management and under continuous monitoring.[27] The combination of opioids, benzodiazepine and propofol is beneficial as compared to propofol alone as single-agent propofol might need higher doses and resultant deep sedation due to lack of analgesic properties.[28] Currently, the evidence supports anaesthesia assistance in difficult endoscopy cases both patient profile and technical difficulties with the endoscopy procedure. Studies in EUS-guided FNA in the pancreas and overtube-assisted enteroscopy showed better outcomes with anaesthesia assistance.[29,30] Also, in procedures where the patient needs particular positioning such as a prone position, airway handling might be difficult, there might be alterations in cardio-respiratory physiology and so a dedicated anaesthesia provider is indicated.[30] To summarise anaesthesia specialist-administered sedation helps in patient and endoscopist satisfaction but may not be indicated in physiologically sound patients posted for diagnostic upper endoscopy or colonoscopy. Also, in difficult, complicated and prolonged procedures in patients with deranged physiology, it is best to be done with sedation/anaesthesia conducted by anaesthesia specialist.[17] The position statement of BSG proposes safe and appropriate sedation practices during rapidly expanding complex gastrointestinal endoscopy procedures for high-quality successful clinical outcomes.[31] The setup for general anaesthesia must be ready in cases with planned sedation including equipment, drugs and staffing. The position statement also stresses upon pre-procedure assessment by a lead anaesthetist in the pre-assessment clinic and adequate time to be taken for evaluation in cases with difficult airways. The patients with anticipated increased fluid in the oesophagus or stomach (variceal bleed or intestinal obstruction) or during the procedure (transgastric pancreatic pseudocyst drainage) should be identified and managed with endotracheal intubation to secure airway. There is also stress on the development of standard operating procedures with close collaboration between endoscopists and anaesthesiologists.

Table 6. ASA definition of level of sedation

		Minimal sedation	Moderate sedation	Deep sedation	General anesthesia
Response to stimulus	Verbal	+	+/-	-	-
	Tactile	+	+/-	-	-
	Noxius stimulus	+	+	+	-
Airway management		No intervention	No intervention	Intervention may be needed	Airway support required
Ventilation		Spontaneous	Spontaneous	Usually, support required	Ventilation support required
Cardiovascular function		Maintained	Usually maintained	Usually maintained	May be impaired

Endoscopy procedure management during COVID-19 pandemic-

COVID-19 pandemic has affected all the modalities and facilities in healthcare system. Endoscopy procedures protocols also had to be modified to decrease the possibilities of contracting the virus. Triage and screening for COVID-19 have been advocated before an endoscopy procedure however, the absolute effect of this COVID-19 testing before endoscopy on the viral transmission may be low with usage of personal protective equipments (e.g.FFP-2 masks).[32] The European Society of Gastrointestinal Endoscopy and the European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGE-ESGENA) position statement 2022 recommends all patients presenting for endoscopy must be either negative for a viral test (PCR or INAAT) within 48 hours of scheduled gastrointestinal endoscopy or have fully documented COVID-19 vaccination status within past 6 months.[33] All patients and staff are required

Figure 1: LMA Gastro (A); endoscope in situ in the gastric channel of LMA gastro(B); View of LMA gstro showing various openings(C); LMA gastro in situ in a patient in supine position(D); Patient in lateral position for endoscopy with LMA gastro insitu(E)

to follow COVID-19 appropriate behaviour at all times including wearing masks and observing social distancing measures. Also, it is recommended for the staff to be fully vaccinated against COVID-19. The endoscopy suits are required to be modified to prevent the spread of infection with areas designated as 'clean area', 'contaminated area' and 'potential contaminated area'. During the procedure, aerosol and droplet generation is attributed to airway manipulation by the anesthesiologist and endoscope insertion, maneuvring and withdrawal by the endoscopist. This results in prolonged airway proximity of the anesthesiologist and endoscopist and elevated viral transmission risk.[34] Various techniques to reduce aerosol generation are advocated such as wet gauze wrapping around the mouth and oral cavity, maintaining deeper planes of anesthesia, administration of antiemetics and antisialagogue, using nasal prongs with lower flows whenever possible, avoiding high flow nasal (HFNC), intubating the patients for complex procedures electively to avoid emergency airway handling, and may be taken into consideration if feasible.[35] The aerosol-generating procedures (AGP) should be ideally performed in a negative pressure room. Few authors have also advocated use of LMA®Gastro™ (Teleflex Medical Europe Ltd, Athlone, Ireland) with viral filter for ERCP for biliary obstruction/ sepsis in patients without aspiration risk or difficult airway to decrease the aerosolization during intubation and emergence period though it is debatable.[36] Overall, gastrointestinal endoscopic procedures when

performed with adequate COVID-19 appropriate protective measures seem safe to perform for the patients as well as health care providers.

Table 7. The Evolving Landscape of Anesthesia Beyond Conventional Operating Rooms in Low- and Middle-Income Countries

Aspect	Problems	Probable Solutions
Changing Trends in Anaesthesia outside operating	There is a huge expansion of anaesthesia services outside the operating room in low-middle income countries. This is hindered by resource constraints, manpower shortage and lack of safety protocols.	The shift in these trends requires adaptation of standard protocols, training of workforce in non-operating room anaesthesia practices (NORA). Infrastructure development and improved resource allocation for these remote anaesthesia locations.
Burden and prevalence of non-operating room (NORA) in low-middle income countries	The overburdened setups of hospitals in these countries with huge backlogs necessitate lack of standard procedural settings. These setups often lack essential monitoring devices such as multiparameter monitors including capnography, essential resuscitation tools such as basic and advanced airway equipments. Higher peri-procedural complications are observed due to sub-optimal perioperative monitoring and care.	The procurement systems for essential monitoring equipments in public institutions need strengthening. This has to be clubbed with implementation of minimum safety standards for non-operating room anaesthesia. Encouraging government and non-government funding agencies for procurement support of anaesthesia services.
Challenges in Training and Workforce Distribution	Many of the low-middle income countries report significantly lower anaesthesiologist to population ratio compared to internationally accepted norms. This leads to non-specialists administering procedural sedation, leading to compromised patient safety.	Streamlining training programs for teams performing anaesthesia services in remote locations. Task sharing models for non-anaesthesiologist physicians and paramedical staff. Using advances in technology and simulation in continuous teaching and training.
Logistic and resource limitations	Non-operating room settings lack reliable supply of essential modalities such as piped oxygen supply, essential anaesthetic and resuscitation drugs. High costs and maintenance of ventilators and workstations seems impractical to administrators.	Adapting monitoring devices which are reliable and durable with low maintenance. Improving supply chain dynamics and strengthening procurement chain for essential drugs and equipments.
Safety and Quality control in non-operating room anaesthesia	Individual practitioner based practices result in variability and increased peri-procedure adverse events.	Development of standard operating protocols considering resource constrains. Structured sedation and monitoring practice development. Establishment of regular audits and regulatory framework.
Strategies for improving non-operating room practices in low to middle income group countries	Non-operating room anaesthesia in these countries has challenges of training, equipment and policy implementation.	Training in non-operating room anaesthesia including technical and non-technical skills for the delivery of high quality safe services. Strengthening of domestic and global partnerships for knowledge sharing and developing local guidelines and protocols for anaesthesia services in non-operating room setups.

CONCLUSIONS

Anaesthesia outside the operating room faces challenges such as resource limitations, workforce shortages, and lack of standardised protocols, especially in high-demand areas like endoscopy. Strengthening training, infrastructure, and safety standards is vital. During the COVID-19 pandemic, endoscopy anaesthesia management required enhanced infection control measures, appropriate PPE use, and careful airway management to minimize aerosol exposure and ensure patient and staff safety.

The mode of anaesthesia is usually deep sedation without any definitive airway device and is frequently associated with hypoxemia events which can be catastrophic. The depth of sedation required for completing these lengthy procedures, non-supine position, restrictions imposed by the fluoroscopy machine and table, non-operation room setting, sharing of the airway, and high-risk profile of patients undergoing these procedures make the conditions particularly challenging for the anaesthesiologist as sedation related respiratory events are rather frequent. An endotracheal tube though considered gold-standard for securing the airway, would prolong the anaesthesia time and delay the recovery. LMA Gastro™ or Gastro-laryngeal tube are specialized supraglottic airway devices meant for endoscopy procedures as it provides access to the gastrointestinal tract simultaneously with a patent airway. These provide the benefit of a secure airway while minimally delaying patient recovery. However, their clinical usage has various pitfalls that can hinder their wider acceptance and practical utility. Future design modifications and robust literature supporting its use will go a long way in the wider adoption of this device. Oxygen therapy using high-flow nasal cannula is gaining popularity in endoscopy procedures as it reduces sedation-related hypoxemia events. Safe sedation practices, the presence of trained staff, minimum mandatory monitoring, appropriate airway and resuscitation equipment and close coordination with the endoscopists is the key to optimal patient outcomes in this challenging non-operating room anaesthesia scenario.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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