

Anesthetic management for small bowel enteroscopy in a World Gastroenterology Organization Endoscopy Training Center

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Abstract

AIM: To study the anesthetic management of patients undergoing small bowel enteroscopy in the World Gastroenterology Organization (WGO) Endoscopy Training Center in Thailand.

METHODS: Patients who underwent small bowel enteroscopy during the period of March 2005 to March 2011 in Siriraj Gastrointestinal Endoscopy Center were retrospectively analyzed. The patients' characteristics, pre-anesthetic problems, anesthetic techniques, anesthetic agents, anesthetic time, type and route of procedure and anesthesia-related complications were assessed.

RESULTS: One hundred and forty-four patients underwent this procedure during the study period. The mean age of the patients was 57.6 ± 17.2 years, and

most were American Society of Anesthesiologists (ASA) class II (53.2%). Indications for this procedure were gastrointestinal bleeding (59.7%), chronic diarrhea (14.3%), protein losing enteropathy (2.6%) and others (23.4%). Hematologic disease, hypertension, heart disease and electrolyte imbalance were the most common pre-anesthetic problems. General anesthesia with endotracheal tube was the anesthetic technique mainly employed (50.6%). The main anesthetic agents administered were fentanyl, propofol and midazolam. The mean anesthetic time was 94.0 ± 50.5 min. Single balloon and oral (antegrade) intubation was the most common type and route of enteroscopy. The anesthesia-related complication rate was relatively high. The overall and cardiovascular-related complication rates including hypotension in the older patient group (aged ≥ 60 years old) were significantly higher than those in the younger group.

CONCLUSION: During anesthetic management for small bowel enteroscopy, special techniques and drugs are not routinely required. However, for safety reasons anesthetic personnel need to optimize the patient's condition.

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Key words: Anesthetic management; Anesthetic technique; Complication; Developing country; Small bowel enteroscopy; Training center

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INTRODUCTION

The small intestine is a difficult area to examine due to its anatomy, location and relative tortuosity. Examination beyond the duodenum is of importance in a number of small bowel disorders. A major breakthrough in imaging of the small bowel came with capsule endoscopy and enteroscopy. However, capsule endoscopy has several limitations such as inability to evaluate a lesion in a to-and fro-manner, inability to provide endoscopic intervention, and inability to obtain tissue for diagnosis^[1,2]. Enteroscopy is now the preferred method to examine the small bowel in most situations.

Enteroscopy describes endoscopic examination of the small bowel, extending into the jejunum and/or the ileum. All enteroscopy procedures can be carried out with the processing unit used for standard endoscopy^[3]. Many methods such as push enteroscopy, balloon-assisted enteroscopy, and intraoperative enteroscopy have now made observations of the entire small bowel possible. However, enteroscopy is an invasive procedure requiring sedation and/or anesthesia. It usually carries a risk of high morbidity during and in the early post-anesthetic period. The type of anesthesia used is decided according to the patient's medical condition and the anesthesiologist's preference. Intravenous sedation (IVS) can be used, but to ensure better patient and endoscopist comfort during this complicated procedure, general anesthesia (GA) is preferred.

We conducted a retrospective study to report and evaluate the choices and techniques of anesthesia, drug usage and complications in enteroscopy patients during the period of March, 2005 to March, 2011 in the World Gastroenterology Organization (WGO) Endoscopy Training Center in Thailand. This study was also performed in order to adapt and store the data for further research in the near future.

MATERIALS AND METHODS

This was a retrospective study. Data from anesthetic, procedure records and history charts of patients who underwent enteroscopy procedures in Siriraj gastrointestinal Endoscopy Center, World Gastroenterology Organization Endoscopy Training Center, Thailand from March 2005 to March 2011 were reviewed. The general data included sex, age, American Society of Anesthesiologists (ASA) physical status, body weight and indications for endoscopy as well as the type and route of intubation. The anesthetic data encompassed pre-anesthetic problems, anesthetic technique, variety of drugs used, monitoring, anesthetic time, agent and complications which evolved during and immediately after the procedure.

Patients

All patients who underwent small bowel enteroscopy procedures during the study period were enrolled. Inclusion criteria were patients aged ≥ 17 years old and procedures performed in the endoscopy unit. Exclusion criteria were patients younger than 17 years and procedures performed in the intensive care units and operating rooms.

Enteroscopy procedure

Enteroscopy procedures were performed by senior endoscopists. All procedures were carried out using an Olympus video endoscope compatible with the enteroscopy procedure. After completion of the procedure, all patients were observed in the recovery room for at least two hours prior to discharge. All patients were admitted to the hospital for at least one day. Patients were observed for both anesthesia and/or procedure-related complications. Procedure-related complications were defined as in the guidelines of the British Society of Gastroenterology^[4].

Anesthesia-related procedure

The anesthetic agents used depended on the patient's medical condition and the familiarity of the anesthesiologist with the particular case. All anesthetized patients were intubated. A balanced anesthesia technique including analgesic agent, muscle relaxant and inhalation agent was used in the GA group. All sedated patients were given supplemental oxygenation *via* a nasal cannula and were sedated to a deep sedation level, according to the guidelines of the American Society of Anesthesiologists^[5] and the American Society for Gastrointestinal Endoscopy^[6]. All patients were anesthetized and/or sedated by well trained anesthetic personnel directly supervised by a staff anesthesiologist in the endoscopy room. Anesthetic personnel included residents in anesthesiology and anesthetic nurses who were well trained in the use of the IVS technique and airway management.

Anesthesia-related complications were recorded. Complications were defined as follows: hypertension or hypotension (increase or decrease in blood pressure by 20% from baseline); tachycardia or bradycardia (increase or decrease in heart rate by 20% from baseline); any cardiac arrhythmias; hypoxia (oxygen desaturation, SpO₂ < 90%); airway obstruction. Serious anesthesia-related complications were defined as cardiac arrest and prolonged desaturation or apnea with duration more than 30 s.

Statistical analysis

Results were expressed as mean \pm SD or percentage (%), when appropriate. Comparisons of anesthesia-related complications between the patients aged < 60 years and ≥ 60 years were performed using Chi-square tests (for categorical variables). The statistical software package SPSS for Windows Version 11 (SPSS Inc., Chicago, IL, United States) was used to analyze the data. All statistical comparisons were made at the two-sided 5% level of significance.

Table 1 Patients' characteristics, anesthetic time and technique, and indications for procedure

Variables	Results (n = 154)
Age (yr) (mean, SD; min-max)	57.6 (17.2); 17-92
Gender (male/female; n %)	75/79 (48.7/51.3)
Weight (kg) (mean, SD)	56.3 (11.0); 30-96
ASA physical status (I, II, III, IV; n %)	15/82/56/1 (9.7/53.2/36.4/0.6)
Anesthetic time (min) (mean, SD; min-max)	94.0 (50.5); 30-290
Anesthetic technique	
GA with endotracheal tube	78 (50.6)
Topical pharyngeal anesthesia and IVS	38 (24.7)
IVS	38 (24.7)
Indications (n %)	
Gastrointestinal bleeding	92 (59.7)
Chronic diarrhea	22 (14.3)
Protein losing enteropathy	4 (2.6)
Others	36 (23.4)

IVS: Intravenous sedation; GA: General anesthesia; ASA: American Society of Anesthesiologists.

RESULTS

There were 154 enteroscopy procedures performed during the study period. The majority of the patients were female, with a mean age of 57.6 ± 17.2 years, and ASA physical status II-III. Mean anesthetic time was 94.0 ± 50.5 min. GA with endotracheal tube was the main anesthetic technique employed. The indications for this procedure are shown in Table 1.

Table 2 shows the endoscopy characteristics and pre-anesthetic problems. Single balloon enteroscopy and antegrade intubation was the most common type and route of procedure. There were 346 pre-anesthetic problems in 154 procedures. They involved mainly hematologic disease; anemia, hypertension and heart disease; coronary artery disease.

Clinical monitoring observed by the anesthetic personnel consisted of non-invasive blood pressure, heart rate, pulse oximetry and electrocardiography. Anesthetic personnel were anesthesiology residents and anesthetic nurses. They sedated and/or anesthetized patients in the endoscopy room outside the operating room directly supervised by a staff anesthesiologist. The anesthetic personnel did not routinely use end-tidal carbon dioxide monitoring. In sedated patients, we did not use end-tidal carbon dioxide monitoring. In comparison, end-tidal carbon dioxide monitoring was used in the majority of intubated patients. Details of the sedative and analgesic agents, inhalation agents and muscle relaxants used are shown in Table 3.

Table 4 demonstrates anesthesia-related complications categorized by age. There was a relatively high complication rate. The most frequent anesthesia-related complication was hypotension which was promptly corrected by the administration of vasopressor and fluid loading. The authors noted that hypotension commonly occurred in the propofol-balanced sedation group after rapid propofol injection. Overall and cardiovascular-

Table 2 Endoscopy characteristics and pre-anesthetic problems

	n (%)
Type of enteroscopy	
Single balloon	105 (68.2)
Push	47 (30.5)
Spiral	2 (1.3)
Route of intubation	
Oral (antegrade)	125 (81.2)
Anal (retrograde)	29 (18.8)
Pre-anesthetic problems	
Hematologic disease	114 (74.0)
Hypertension	54 (35.1)
Heart disease	48 (31.2)
Electrolyte imbalance	46 (29.9)
Renal disease	23 (14.9)
Diabetes mellitus	18 (11.7)
Others	43 (27.9)

related complications including hypotension in the group of patients aged ≥ 60 years were significantly higher than those in the younger group. One patient who underwent IVS developed cardiac arrest during the procedure due to unresolved airway management. However, the patient was successfully resuscitated. According to ASA physical status, overall and cardiovascular-related complications including hypotension in patients who had ASA physical status III-IV were significantly higher than in patients who had ASA physical status I-II. However, anesthesia-related complications between gender, anesthetic time (60 min *vs* > 60 min), and anesthetic technique were not significantly different.

DISCUSSION

Enteroscopy is an effective technique for the diagnosis and treatment of small bowel abnormalities with few complications. All enteroscopy procedures require sedation and/or anesthesia except capsule enteroscopy. The most common indication for all enteroscopy procedures is diagnosis and/or therapy of acute or chronic gastrointestinal bleeding. Other indications include Crohn's disease, stricture, ulcer, polyposis syndrome, mass, foreign body, chronic diarrhea, malabsorption, lymphoma and imaging abnormalities^[1,7].

All endoscopes used in our endoscopy unit were Olympus video endoscopes. Therefore, double balloon enteroscopy procedures were not performed. Two spiral enteroscopy procedures were carried out by an expert endoscopist during a workshop demonstration. In addition, our endoscopists were familiar with the single balloon endoscope. Anesthesiologists had limited experience with this procedure. However, anesthesia for small bowel enteroscopy procedures was relatively safe and effective. No serious adverse events occurred. The authors have used the small bowel enteroscopy procedure since 2005 which has reduced the number of operations, the risk of prolonged anesthesia, and special anesthetic techniques. However, the present study was limited by time, thus the treatment given in certain cases was not

Table 3 Anesthetic agents used (*n*, %)

	<i>n</i> (%)
Sedative and analgesic agents	
Propofol	139 (90.3)
Thiopental	15 (9.7)
Midazolam	88 (57.1)
Fentanyl	150 (97.4)
Muscle relaxation	
Succinyl choline	76 (49.4)
Atracurium	53 (34.4)
Cis-atracurium	21 (13.6)
Rocuronium	5 (3.2)
Vecuronium	4 (2.6)
Inhalation agents	
Isoflurane	43 (27.9)
Sevoflurane	34 (22.1)
Desflurane	5 (3.2)

completed and further therapy is expected to continue.

There are two basic choices of anesthesia for the enteroscopy procedure, these are the IVS and GA techniques, which have advantages and disadvantages. With the IVS technique, anesthetic agents can be reduced and patients have a rapid recovery, however, control of respiration and the cardiovascular system are more difficult. In addition, there is a high number of procedure- and sedation-related respiratory complications. With the GA technique, the control of respiration and the cardiovascular systems is more reliable. In our center, IVS in the retrograde intubation technique is commonly used due to the reasons given in conjunction with anesthesiologist preference. In comparison, the authors normally use GA with endotracheal tube in antegrade intubation.

Because our center is a tertiary care teaching hospital, more difficult patients are referred for enteroscopy under GA. Additionally, more therapeutic enteroscopy procedures are performed in patients under GA, and these patients have more interventions at the same time compared to patients with IVS^[8]. In our hospital, the experience of the endoscopists is not taken into account in the indication to perform enteroscopy under GA. However, it is tempting to speculate that these patients in particular may benefit from the GA technique with less experienced endoscopists. Moreover, cardiopulmonary and other diseases which are more frequent in older patients have been regarded as the major risk factors for complications associated with endoscopy or sedation^[9-11]. Old age as an important risk factor for endoscopy, but is not an indication for providing GA more frequently for enteroscopy at our institution. However, this depends on the experience of the anesthesiologists themselves.

The benefits of the higher efficacy and success rate of small bowel enteroscopy under GA compared to IVS were not confirmed in the present study. However, it has been reported that additional time for preparation is required for enteroscopy under GA, with induction of anesthesia and intubation of the patient^[12]. In addition, 15-30 min of surveillance in a post-anesthesia care unit need to be added to the additional time required for en-

Table 4 Anesthesia-related complications categorized by age (*n*, %)

Adverse events	< 60 yr (<i>n</i> = 75)	≥ 60 yr (<i>n</i> = 79)	<i>P</i> value
Overall	29 (38.7)	47 (59.5)	0.010 ¹
Cardiovascular	25 (33.3)	43 (54.4)	0.008 ¹
Hypotension	21 (28.0)	41 (51.9)	0.003 ¹
Bradycardia	3 (4.0)	1 (1.3)	0.286
Arrhythmia	0	1 (1.3)	0.328
Cardiac arrest	1 (1.3)	0	0.303
Respiratory	4 (5.3)	4 (5.1)	0.94
Hypoxia (SpO ₂ < 90%)	0	1 (1.3)	0.328
Upper airway obstruction	4 (5.3)	3 (3.8)	0.647

¹Considered to be statistically significant.

teroscopy under GA.

At our center, the most common enteroscopy procedures are single balloon and push enteroscopies. These are normally performed in the left lateral position. When the supine position is preferred to improve visualization in difficult cases, insufficient airway protection may occur during IVS. GA is, therefore, often used at our center to protect the airways during time consuming endoscopy procedures in the supine position.

Propofol is widely used for anesthesia outside the operating room, and has a good safety and efficacy profile due to its quick onset of action, rapid metabolism, significantly shorter recovery time and it has some anti-emetic effects^[13,14]. Midazolam is also widely used because of its more rapid onset of action and shorter duration of effect compared with diazepam^[15]. Fentanyl has a short half-life and rapid onset of action, and may have an advantage over pethidine in elderly patients. We usually use propofol, midazolam and fentanyl for endoscopic procedures including small bowel enteroscopy. A low dose of midazolam, combined with low dose fentanyl and propofol, was safe and effective, and did not prolong recovery time even in elderly patients^[10,11,16,17]. In GA, short-acting muscle relaxants (atracurium and cis-atracurium) and short-acting inhalation agents (isoflurane, sevoflurane and desflurane) are commonly used for short procedures^[18].

The present study had a relatively high overall rate of anesthesia-related complications. This rate was higher than that commonly reported, and there may be several explanations for this. We used the following criteria to define complications: hypo/hypertension and brady/tachycardia measured as the changes of blood pressure and heart rate of more than 20% of baseline values. Hypoxia was defined as oxygen saturation < 90%. Moreover, if only serious complications were assessed, the complication rate was only 0.6%, which corresponds to previously published studies^[19]. In our study, one serious complication related to IVS was observed.

Small bowel enteroscopy is an invasive endoscopy procedure. This procedure requires not only endoscopists but also anesthetic personnel to observe and take care of the patients. Clinical signs should be carefully

observed because the occurrence of complications has more significance in elderly patients. However, there was no need for special techniques or drugs in anesthesia in this study. For safety reasons anesthetic personnel need to optimize the patients' condition and should be aware of complications.

COMMENTS

Background

Small bowel enteroscopy is the current standard approach for diagnosis and treatment of small bowel abnormalities. It is an invasive and long procedure. Anesthesia is usually used for this endoscopy procedure. However, there are no reports regarding the anesthetic management of patients undergoing small bowel enteroscopy.

Research frontiers

The authors undertook a retrospective study to assess the anesthetic management of patients undergoing small bowel enteroscopy in the World Gastroenterology Organization Endoscopy Training Center in Thailand.

Innovations and breakthroughs

Pre-procedural assessment and preparation is essential for small bowel enteroscopy. Deep sedation and general anesthesia techniques are safe and effective for this procedure. In addition, special anesthetic techniques and drugs are not routinely required.

Applications

General anesthesia with tracheal intubation should be used for antegrade intubation with prolonged procedure time. Retrograde intubation can be performed safely using deep sedation or general anesthesia techniques.

Peer review

The authors have presented a well written documentation of anesthetic management for small bowel enteroscopy.

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