



Double balloon enteroscopy examinations in general anesthesia

Laszlo Zubek, Lena Szabo, Peter Laszlo Lakatos, Janos Papp, Janos Gal, Gabor Elo

Laszlo Zubek, Janos Gal, Gabor Elo, Department of Anaesthesiology and Intensive Therapy, Semmelweis University, Budapest 1125, Hungary

Lena Szabo, 2nd Department of Pediatrics, Semmelweis University, Budapest 1094, Hungary

Peter Laszlo Lakatos, Janos Papp, 1st Department of Medicine, Semmelweis University, Budapest 1083, Hungary

Author contributions: Zubek L and Elo G designed the study; Zubek L, Elo G, Lakatos PL, Papp J and Gal J performed the research; Zubek L and Szabo L analyzed the data; Zubek L, Szabo L and Elo G wrote the manuscript; Lakatos PL, Papp J and Gal J revised the manuscript; all authors have approved the final draft submitted.

Correspondence to: Laszlo Zubek, MD, LD, Department of Anaesthesiology and Intensive Therapy, Semmelweis University, Kutvolgyi str 4, H-1125 Budapest, Hungary. lzubek@freemail.hu
 Telephone: +36-1-3251236 Fax: +36-1-3251148

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Abstract

AIM: To demonstrate that the double balloon enteroscopy (DBE) can be safely performed in general anesthesia with intubation.

METHODS: We performed a retrospective examination between August 2005 and November 2008 among patients receiving intubation narcosis due to DBE examination. The patients were grouped based on sex, age and physical status. Anesthesia records included duration of anesthesia, quantity of medication used and anesthesia-related complications. We determined the frequency of complications in the different groups and their relation with the quantity of medication used and the duration of anesthesia.

RESULTS: We compiled data for 108 cases of general anesthesia with intubation. We did not observe any permanent anesthesia-related complications; the most frequent side effects of anesthesia were hypo-

tension (30.55%), desaturation (21.29%), and apnea (17.59%). These complications were significantly more frequent among patients with multiple additional diseases [hypotension (23.1% vs 76.9%, $P = 0.005$), desaturation (12.3% vs 69.2%, $P < 0.001$) and apnea (7.7% vs 53.8%, $P = 0.001$)], however, their incidence was not proportional to the quantity of medication used or the duration of anesthesia.

CONCLUSION: General anesthesia with intubation is definitely a viable option among DBE methods. It is highly recommended in patients with multiple additional diseases.

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Key words: Double balloon enteroscopy; General anesthesia; Intubation; Sedation; Patient autonomy

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INTRODUCTION

Although gastroenterological endoscopic examinations are performed with some form of sedation or anesthesia at increasing rates worldwide, gastroscopy and colonoscopy are still often performed without any sedation, even today^[1]. A reason for the widespread use of anesthesia is that patients receiving sedation are more satisfied, because they recall less pain and discomfort related to the intervention. Also, gastroenterology specialists

can examine patients that are otherwise not suitable for examination because of psychological reasons or strong abdominal pain.

However, the dissemination of gastroenterology sedation has limitations^[2]. This is partly because the intervention costs significantly more because of personnel and infrastructure requirements, and also because anesthesia itself may also have moderate or severe side effects^[3]. According to the literature, over 50% of the complications are heart- or lung-related (aspiration, airway obstruction, low ventilation frequency, vaso-vagal episode, over-sedation). So far, there is no consensus on whether sedation should be performed by gastroenterology specialists, anesthetist physicians or assistants, or the patient (patient-controlled anesthesia); or whether the medication should be administered as a bolus, as a continuous infusion, or automatically provided based on pre-calculated plasma level (target controlled infusion)^[4].

The emergence of double balloon enteroscopy (DBE) among endoscopic examinations also means a shift of paradigm for internal medicine specialists, because its safe and efficient completion requires an advanced level of anesthesia. As the method has only been widely used for a couple of years, little data are available on the respective anesthetic procedures. According to the literature, three methods of sedation are used with significant geographical preferences, including conscious sedation, deep sedation (propofol anesthesia) and general anesthesia.

The goal of our research was to assess the suitability and advantages of general anesthesia with intubation for DBE.

MATERIALS AND METHODS

Patients

We retrospectively analyzed the data from 108 patients that had not been pre-selected, in whom DBE was carried out under general anesthesia with intubation. The interventions were carried out in the 1st Department of Internal Medicine of Semmelweis University, Budapest, Hungary between August 2005 and November 2008. Patients were classified into groups based on sex, age, physical status (ASA Physical Status Classification System) and DBE indication^[5]. Anesthesia records included the duration of the intervention, anesthesia protocol, quantity of medication used, and complications.

Following recovery from anesthesia, the patients were asked to recall memories of the intervention and describe any possible complaint.

Method of anesthesia

Electrocardiography and transdermal oxygen saturation were constantly monitored during the intervention, and non-invasive blood pressure measurements were also performed every 5 min. Based on the literature, the definitions were as follows: hypotension, systolic blood pressure < 90 mmHg; desaturation, transdermal oxygen saturation < 90%; and apnea, > 30 s pause in respiration.

During intervention, proper anesthesia was provided

by the combined administration of benzodiazepine, opioids and propofol in all cases; the mentioned medications were selected based on availability because these are all readily available in every endoscopy laboratory. We supposed that complete anesthesia was reached with their combined usage, and we also wished to adapt continuously the degree of anesthesia to the requirements of the intervention.

First, peripheral venous access was provided, and then infusion was administered (500-1000 mL). All patients received 0.5 mg atropine prior to the intervention, followed by gradual intravenous midazolam injection (3-10 mg) to reach a consciousness level equivalent to conscious sedation. All patients received 1-1.5 µg/kg fentanyl, and induction of narcosis was achieved by 1 mg/kg propofol as a bolus. For the maintenance of narcosis, further doses of propofol were used. We used two anesthesia protocols. According to these, propofol was either provided as continuous infusion or given in discrete fractions. In the case of continuous use, the infusion rate was set at 200 mg/h; for fractioned use, 25 mg fractions were given as a bolus following induction and intubation, until the end of intervention. If the degree of anesthesia was insufficient (patient motion, changes in vegetative reactions), we increased the speed of propofol infusion, or another fraction was administered. Fentanyl was repeatedly provided every 30 min at 0.5-1 µg/kg.

Statistical analysis

Arithmetic mean and SD values were used for continuous parameters, whereas frequency percentages were calculated for discrete parameters. Statsoft version 8.0 software (www.statsoft.com) was used for statistical analysis. The quantity of medication was compared using non-parametric variance analysis (Kruskal-Wallis analysis of variance), and the frequency of the observed complications was compared with Fisher's exact test among the various groups. $P < 0.05$ was considered statistically significant.

RESULTS

The indications for intervention in the 108 patients enrolled in the study are presented in Table 1. In patients with obscure gastrointestinal bleeding (OGIB), abnormal small-bowel findings were seen in 41 patients (65.1%). Most of them were classified as probable (angiodysplasia, erosion), and others as definitive (e.g. small ulcers) causes of bleeding. Other definitive causes were malignant disease, found in five patients, including polypoid gastrointestinal stromal tumor (GIST) in three patients, non-Hodgkin lymphoma (NHL) in one, and melanoma in one. In suspected inflammatory bowel disease (IBD), enteroscopy confirmed the diagnosis in five out of 12 cases. In patients with suspected neoplasia/stenosis, malignant disease was proven in three cases. In patients with known polyposis syndromes [familial adenomatous polyposis (FAP) or Peutz-Jeghers syndrome], small-bowel polyps were removed in eight patients. The average insertion length was 209 cm (50-460 cm, SD: 113 cm). Using the oral route ($n = 95$), a larger proportion of the

	<i>n</i> (%)
Suspected malignancy/stenosis	8 (7.4)
OGIB	63 (58.3)
Peutz-Jeghers syndrome	5 (4.6)
Polyposis	6 (5.6)
Angiodysplasia	6 (5.6)
IBD	12 (11.1)
Chronic cramping pain	6 (5.6)
Unknown fever or loss of weight	1 (0.9)
Irritable bowel syndrome	1 (0.9)

DBE: Double balloon enteroscopy; OGIB: Obscure gastrointestinal bleeding; IBD: Inflammatory bowel disease.

	P1 (SD)	P2 (SD)	P3 (SD)	Sum (SD)
<i>n</i>	65	30	13	108
Age (yr)	45.88 (15.93)	60.42 (13.36)	70.69 (19.47)	52.53 (18.44)
Duration (min)	91.85 (24.79)	79.17 (19.17)	65.77 (10.77)	85.18 (23.72)
Propofol (mg)	464.31 (91.84)	410.33 (66.82)	346.92 (61.29)	435.18 (91.16)
Midazolam (mg)	7.17 (1.29)	5.50 (1.04)	4.08 (0.76)	6.31 (1.60)
Fentanyl (mg)	0.1307 (0.0350)	0.1217 (0.0284)	0.0731 (0.0259)	0.1213 (0.0369)

small intestine was accessible for examination (226 cm, SD: 107 cm) compared with procedures that started with anal endoscope insertion and colonoscopy ($n = 13$, 98 cm, SD: 58 cm, $P < 0.01$).

Fifty-five patients were male (50.92%) and 53 were female (49.08%), with the average age being 52.53 years (SD: 18.44 years). The patients were classified into three groups based on the ASA Physical status classification system (ASA P1-P3). P1 included 65 patients (average age: 45.87 years, SD: 15.93 years), P2 included 30 patients (average age: 60.42 years, SD: 13.36 years), and P3 included 13 patients (average age: 70.69 years, SD: 19.47 years). The three groups were compared based on the duration of the intervention, the quantity of medication used, and the observed complications. Demographic and clinical data of the three groups are shown in Table 2.

The average length of the intervention was 85.18 min (SD: 23.72 min); with 91.85 min in P1 (SD: 24.79 min), 79.17 min (SD: 19.17 min) in P2, and 65.77 min (SD: 10.77 min) in P3. Although the time of intervention gradually decreased with deteriorating physical status, a significant difference was only found between P1 and P3 ($P < 0.001$).

The average amount of propofol used during the intervention was 435.18 mg (SD: 91.16 mg) per patient, with 464.31 mg (SD: 91.84 mg) in P1, 410.33 mg (SD: 66.82 mg) in P2, and 346.92 mg (SD: 61.29 mg) in P3. The dose of propofol decreased in patients with deteriorating physical status and significant differences were found between groups P1 and P2 ($P = 0.027$) and P1 and P3 ($P < 0.001$).

	P1	P2	P3	Sum
<i>n</i>	65	30	13	108
Hypotension	15 (23.1)	8 (12.3)	10 (76.9)	33 (30.6)
Desaturation	8 (12.3)	6 (20.0)	9 (69.2)	23 (21.3)
Apnea	5 (7.7)	7 (23.3)	7 (53.8)	19 (17.6)

The average quantity of midazolam used per patient was 6.31 mg (SD: 1.60 mg); with 7.14 mg (SD: 1.29 mg) in P1, 5.5 mg (SD: 1.04 mg) in P2, and 4.08 mg (SD: 0.76 mg) in P3. Significant differences were found between the groups P1 and P2 ($P < 0.001$) and P1 and P3 ($P < 0.001$), as well as P2 and P3 ($P = 0.045$). The average amount of fentanyl used per patient was 0.1213 mg (SD: 0.0369 mg); with 0.1307 mg (SD: 0.0350 mg) in P1, 0.1217 mg (SD: 0.0284 mg) in P2, and 0.0731 mg (SD: 0.0259 mg) in P3. Significant differences were found between groups P1 and P3 ($P < 0.001$) and P2 and P3 ($P = 0.001$).

Among anesthesia-related complications recorded during the intervention, hypotension, desaturation and apnea occurred frequently. Table 3 presents the number of complications and their comparison between the groups. We analyzed statistically the correlation between the occurrence of the above complications (hypotension, desaturation and apnea) and patients' physical status, the duration of the intervention, and the quantity of medication (propofol, midazolam, fentanyl).

Only the physical-status-based classification and the occurrence of the recorded complications showed a significant positive correlation. ASA P stage significantly influenced the frequency of hypotension ($P = 0.005$), de-saturation ($P < 0.001$) and apnea ($P < 0.001$). These complications were more frequently observed among patients classified into group P3 than would have been expected based on random incidence.

A significant positive correlation was not found between the quantity of medication and complications. There was a significant negative correlation between propofol dosage and the development of hypotension ($P = 0.002$). We found a significant negative correlation between midazolam dosage and the three most frequent complications (hypotension, $P = 0.001$; de-saturation, $P = 0.004$; apnea, $P = 0.001$). There was a significant negative correlation between fentanyl dosage and desaturation ($P = 0.003$), but not with the other complications. There was a significant negative correlation between the duration of the intervention and the frequency of desaturation ($P = 0.018$) and apnea ($P = 0.040$).

Among the 108 DBE anesthesia cases, three imminent anesthesia-related problems had to be resolved. In one case, peripheral venous access could not be provided due to the physical status of the patient, but instead, central venous access was established without any complication. In another case, intubation could not be completed and hence enteroscopy had to be delayed. One week later, both the intubation and intervention were completed with

the application of a depolarizing muscle relaxant. For a third patient, who had obesity and chronic obstructive pulmonary disease, continuous respiration assistance and oxygen supply had to be provided, and extubation could only be performed in the seated position due to breathing difficulty.

Anesthesia was not related to any permanent or severe complication (aspiration, malignant dysrhythmia, resuscitation, malignant hyperthermia) in any case. More than 98% of the patients had amnesia concerning events during anesthesia. Frequent complaints included discomfort at the site of peripheral venous access, sore throat or dysphagia, and abdominal distension.

DISCUSSION

Thanks to international recommendations based on the accumulating amount of data published about sedation techniques related to endoscopic interventions performed in the gastrointestinal tract, these interventions have become extremely safe^[6-8]. Severe complications are generally rare and deadly fatal complications mostly affect patients in a severely impaired or terminal physical state^[9]. Data concerning recently introduced enteroscopic examinations and the related sedation techniques are scarce, and randomized, multicenter comparative studies with large numbers of patients have been lacking.

The goal of our study was to examine the utility of general anesthesia with intubation as a method of choice for DBE. The enrolled patients were divided into three groups according to the ASA Physical Status Classification System.

We first examined whether the 108 enteroscopy cases corresponded with published data in terms of intervention indications and duration. Among the indications, OGIB (58.33%), IBD (11.11%) and tumor (7.41%) were the most frequent in our practice, as in the literature (OGIB: 59%-62.8%; IBD: 2.9%-6.4%; tumor: 8.3%-10.2%)^[10-12]. The average duration of the intervention in our study (85.18 min) was also found to be similar to that in the literature (53-113 min)^[13,14]. The detailed outcome of the endoscopic procedures has been published in a separate paper^[15].

However, we need to highlight some differences in sedation complications. Anesthesia-related complications occurred at much higher frequencies in our practice than during conscious sedation described in the literature, but these have either quickly resolved without any or with minor medical intervention. Hypotension was found to be the most frequent complication in our study (30.55%), which occurred at much lower frequencies during conscious sedation (1.8%-23.08%)^[10,13,16]. If hypotension was observed, we increased intravenous fluid therapy, although the positive effects of the procedure are not obvious^[17], and we also decreased the administration of propofol and fentanyl. Hypertensive drugs were not used in any case, and hypotension resolved within minutes with the above procedures.

The frequency of desaturation was 21.29% in our study, which is similar to the frequencies reported in the

literature (0%-30.78%)^[13,18]. In cases of hypoxia, transient or continuous oxygen inhalation was necessary, depending on the patient's requirements, and if oxygen levels normalized, we discontinued oxygen administration. Apnea was observed in 17.59% of the cases in which respiratory assistance was initiated, which was discontinued as soon as spontaneous respiration was restored. However, some patients required continuous respiratory assistance during the intervention. The severe complication of aspiration did not occur during intubation, and probably this is the most prominent difference between intubation and conscious sedation (0% *vs* 1.2%-2.77%).

We found a significant positive correlation between the number of complications and poor physical status. Poor physical status and senior age both predict occurrence of hypotension, desaturation and apnea. With the increase in ASA physical status level, the duration of the intervention and the quantity of medication decreased.

We consider it important to highlight that side effects observed during anesthesia are not related to medication use, because there was no significant positive correlation found between the frequency of complications and dose of propofol, midazolam or fentanyl. For some complications, the opposite was true, as patients with poor health status (P3), who experienced the most complications, received much less anesthetic.

The amount of medication used for narcosis in our study was higher than that required for examinations performed under conscious sedation^[13]. The reason for this is that a greater amount of medication is required for deeper sedation (general anesthesia). Also, patients receiving orotracheal intubation require more medication to tolerate the procedure.

The ratio of complete amnesia observed among patients examined in intubation narcosis was much higher (98%) than among those receiving venous sedation (24%-56%)^[14].

Therefore, who is advised to undergo general anesthesia as an alternative sedation method performed by an anesthetist? Every patient who belongs to a sedation-related risk group. Such risk factors include emergency interventions; senescence; cardiac, lung, renal or liver diseases possibly resulting in organ failure; pregnancy; drug or alcohol abuse; disorientation; post-prandial or non-cooperative patients, and alleged airway obstruction^[4]. In our study, patients classified as P3 or higher also belonged to the high-risk group, therefore, ASA physical status helps us to choose the right method of anesthesia.

General anesthesia with intubation was a viable option when performing DBE in all three patient groups. With the deterioration of physical status (increasing ASA P status), the advantage of intubation narcosis increases compared to other sedation methods. In the case of poor physical status, the number of complications significantly increases, however, these are readily treatable due to pre-existing intubation. The occurrence of hypoxia, apnea or aspiration can result in an emergency situation in patients sedated without intubation, which can lead to deterioration of the patient's physical status and halt the course of

the examination, thus significantly increasing the number of complications and healthcare costs. General anesthesia can also be used safely in ASA groups P1-2 because severe or permanent anesthesia-related complications have not been observed in any case. Alternative anesthetic methods that suit the patient's needs will be justified in the future if, in the institutions performing enteroscopy, venous sedation (conscious or deep) and general anesthesia are provided. Self autonomy of patients with good health status, who are suitable for ambulatory intervention (ASA P1-2), should be emphasized, and after providing sufficient information, choices of alternative anesthesia methods should be offered.

Our study had some limitations, because the study was retrospective and patients were not randomized. Patient numbers were not equal between the groups, with especially few patients in group P3. Another limitation was that we performed only general anesthesia with intubation; the other sedation methods that were used for comparison were based on published data only. We compared the average frequency of side effects observed in our patients with those reported in the literature.

COMMENTS

Background

Three methods of sedation are used for double balloon enteroscopy (DBE), with significant geographical preferences, including conscious sedation, deep sedation (propofol anesthesia) and general anesthesia. The goal of this research was to assess the suitability and advantages of general anesthesia with intubation for DBE.

Research frontiers

The best anesthetic method for DBE is not clear at present, because all sedation methods have many different advantages and disadvantages.

Innovations and breakthroughs

This research shows that the ASA physical status classification system helps us to choose the right anesthetic method. With the deterioration of physical status (increasing ASA P status), the advantage of intubation narcosis increases compared to other sedation methods. The authors found a significant positive correlation between the number of complications and poor physical status. They consider that the side effects observed during anesthesia are not related to medication use.

Applications

Based on the results of this clinical study, general anesthesia with intubation was a viable option for DBE in all three patient groups. Alternative anesthetic methods that suit the patient's needs will be justified in the future in institutions that perform enteroscopy.

Peer review

The study demonstrates that the double balloon enteroscopy examination can also be safely performed in general anaesthesia with intubation.

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