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Esophagogastroduodenoscopy Procedure in Sick Pediatric Patients: A Comparison between Deep Sedation and General Anesthesia Technique

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Abstract

Objectives: To compare and evaluate the clinical efficacy of deep sedation and general anesthesia for esophagogastroduodenoscopy (EGD) in sick pediatric patients (ASA physical status ≥ III) in a tertiary care teaching hospital in Thailand.

Subjects and methods: We undertook a retrospective review of the anesthesia service records of sick pediatric patients who underwent EGD. All sick pediatric patients were classified into two groups according to the type of anesthetic technique: group DS (deep sedation) and group GA (general anesthesia). The primary outcome variable of the study was the successful completion of the procedure. Failed procedure is defined as the procedure can not be completed by using DS or GA technique or anesthesia-related serious adverse events such as severe hypoxemia (SpO2 < 85% more than 3 minutes and can not relief by airway management), severe cardiorespiratory instability, are occurred. The secondary outcome variables were anesthesia/sedation-related complications during and immediately after the procedure.

Results: 101 sick patients underwent EGD procedure during the study period. Premedications were none prior to the procedure. After matching age, gender, weight and indications of procedures, there were 51 patients in group DS and 27 patients in group GA. There were no significant differences in age, gender, weight, ASA physical status and indications of procedures. However, the duration of anesthesia in group GA was significantly longer than in group DS (p= 0.004).All DS and GA techniques were used successfully in all but one in group DS. Mean dose of propofol and fentanyl in both groups was comparable. Overall complication rate in group DS was significantly higher than in group GA (p= 0.039). However, there were no significant differences in the sedation and procedure related complications, anesthetic personnel and mortality rate.

Conclusion: In the setting of the developing country, DS and GA for EGD in sick pediatric patients by experienced anesthesiologist with appropriate monitoring were relatively safe and effective. Serious adverse events were rare in our population.

Keywords: Esophagogastroduodenoscopy; Sick; Pediatric; Deep sedation; General anesthesia

Introduction

Because of the availability of newer and smaller endoscopes, the utilization of endoscopy to diagnose gastrointestinal disorders in children is increasing. Esophagogastroduodenoscopy (EGD) procedure in pediatric patients can be completed with sedation, or with general anesthesia [1-3]. However, the method by which a child is sedated during the procedure remains controversial. The goals of sedation are to ensure patient safety, provide analgesia and amnesia, control behavior during the procedure, enable successful completion of the procedure, and quickly return the patient to pretreatment level of consciousness.

In a developing country like Thailand, pediatric endoscopy is being performed at increasing rate. In addition, in provincial or community hospitals, general anesthesia remains the sedation of choice for pediatric EGD procedure. At Siriraj hospital, a World Gastroenterology Organization (WGO) Endoscopy Training Center, there is a dedicated gastrointestinal endoscopy unit and dedicated anesthesiology service for the unit. Over the years, we have observed a change in trend of sedation for pediatric EGD towards deep sedation (DS) technique. However, this sedation technique will be controversy especially in sick pediatric patients. This study, therefore, is done to compare and evaluate the clinical efficacy of DS and general anesthesia (GA) for EGD procedure in sick pediatric patients (ASA physical status ≥ III). The authors hypothesize that the clinical efficacy of GA with endotracheal tube for EGD procedures in sick pediatric patients may be more successful and less complication than the DS technique.

Methods

Patients

The pediatric patients who underwent EGD procedures at Siriraj GI Endoscopy Center, Faculty of Medicine Siriraj Hospital between July 2006 and January 2010 were enrolled in the present study. Inclusion criteria were the sick pediatric patients (ASA physical status ≥ III) who underwent EGD procedures. The EGD procedures performed in the operating rooms and the intensive care units, the procedures performed under monitored anesthesia care, topical anesthesia and mild or moderate sedation technique, and the patients who had endotracheal tubes before the procedure were excluded.

Study design

This study was a retrospective study. All sick pediatric patients

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were classified into two groups according to the type of anesthetic technique. In group DS, the patients underwent EGD procedures by using deep sedation technique. In group GA, the patients underwent EGD procedures by using general anesthesia with endotracheal tube technique. The primary outcome variable of the study was the successful completion of the procedure. Failed procedure is defined as the procedure which cannot be completed by using DS or GA technique or the anesthesia/sedation-related serious adverse events such as severe hypoxemia (SpO_2 < 85% more than 3 minutes and can not relief by airway management), severe cardiorespiratory instability. The secondary outcome variables were anesthesia/sedation-related complications during and immediately after the procedure.

Endoscopy procedure

All EGD procedures were done using an Olympus video esophagoduodenoscope (GIF-XP 1602/2, Olympus Corporation, Tokyo, Japan). The success rate in both groups was recorded. The successful completion of the procedure defined as completion of the procedure as intended without additional GA once the procedure had started in group DS, or without severe hemodynamic instability. After completion of the procedure, admission into the inpatient hospital service was arranged to rule out post-EGD complications.

Anesthesia/sedation-related procedure

The patients were monitored with non-invasive blood pressure, ECG and pulse oximetry. End-tidal carbon dioxide (CO_2) monitoring with capnography was not used during DS, but it was used during GA with endotracheal tube. All patients in group DS received oxygen supplement via oxygen cannula (3 liters/minute). All patients in group GA were utilized by using balanced anesthesia including inhalation agent, opioid and muscle relaxant drug. All pediatric patients in group DS were sedated in deep sedation level, according to guidelines of the American Society of Anesthesiologists [4]. Sedative/analgesic agents used in group DS were propofol, midazolam and/or fentanyl. The dose of sedative and analgesic agents was assessed.

Anesthesia/sedation-related adverse events

All anesthesia/sedation-related adverse events were recorded. Sedation related adverse events were defined as follows: hypertension or hypotension (increase or decrease in blood pressure by 30% from baseline); tachycardia or bradycardia (increase or decrease in heart rate by 30% from baseline); any cardiac arrhythmias; hypoxia (oxygen desaturation, SpO_2 < 90%); airway obstruction.

Statistical analysis

Results were expressed as mean ± SD or percentage (%), when appropriate. Comparisons between group DS and GA were compared by using with Chi-square tests (for categorical variables), Chi-square tests for trend (for ordinal variables), and two-sample independent t-test (for continuous variables). The statistical software package SPSS for Window Version 11 (SPSS Inc., Chicago, IL) was used to analyze the data. All statistical comparisons were made at the two-sided 5% level of significance.

Results

During the study period, a total of 242 patients underwent 259 EGD procedures. Of these, 101 children (41.7%) were sick patients. All anesthesia/sedation was given by the anesthetic personnel directly supervised by staff anesthesiologist physically present in the endoscopy room. Anesthetic personnel included second-year residents in the Anesthesiology residency program and anesthetic nurses who are well trained in GA, intravenous sedation, airway management including intubation, and cardiopulmonary resuscitation. There were no premedications prior to the procedure. All endoscopic procedures were performed by a pediatric gastroenterologist.

After matching age, gender, weight and indications of procedures, there were 51 patients in group DS and 27 patients in group GA. Patient characteristics, duration of anesthesia and indications of procedures are listed in table 1. There were no significant differences in age, gender, weight, ASA physical status and indications of procedures. However, the duration of anesthesia in group GA was significantly longer than in group DS (p=0.004).

Table 2 showed the success rate and sedative agents used in both groups. All DS and GA techniques were used successfully in all but one in group DS. The one patient who failed DS was a 7-month old child developed upper airway obstruction. Despite efforts to maintain the patient's airway, the obstruction was not resolved. The patient was then intubated for airway management. After the patient's respiratory status had improved, the procedure was completed with GA. There were no significant differences in the mean dose of propofol and fentanyl in both groups. Additionally, all patients in group DS were utilized with midazolam. The inhalation agents used in group GA were sevoflurane and isoflurane, and the muscle relaxant drug used in group GA was atracurium.

Table 3 showed overall complication rate, sedation and procedure related complication, anesthetic personnel and mortality rate. Overall complication rate in group DS was significantly higher than in group GA (p=0.039). However, there were no significant differences in the sedation and procedure related complications as well as anesthetic personnel. All complications were easily treated and managed with medication and/or maintenance of the patient's airway by the staff anesthesiologist or anesthetic personnel under direct supervision of the staff anesthesiologist who was physically present in the room. Mortality rate was none in both groups.

Discussion

This retrospective study demonstrates that DS for EGD procedures in sick (ASA physical status ≥ III) pediatric patients in a World Gastroenterology Organizing Endoscopy Training Center in Thailand by trained anesthetic personnel with appropriate monitoring is safe and effective as GA technique. Serious adverse events are rare in our

	Group DS (n=51)	Group GA (n=27)	P value
Age (yr) (mean, SD)	7.4 (3.9)	3.9 (4.3)	0.059
Gender (%): Male	26 (51.0)	11 (40.7)	0.389
Famale	25 (49.0)	16 (59.3)	
Weight (kg) (mean, SD)	22.9 (10.7)	16.3 (10.3)	0.347
ASA physical status (%): III	51 (100.0)	26 (96.3)	0.167
IV	0	1 (3.7)	
Duration of anesthesia (min) (mean, SD)	27.3 (5.6)	35.2 (10.1)	0.004*
Indications of procedure			0.105
Esophageal varice	24 (47.0)	12 (44.5)	
Upper gastrointestinal hemorrhage	8 (15.7)	8 (29.6)	
Abdominal pain	6 (11.8)	2 (7.4)	
Chronic anemia	5 (9.8)	2 (7.4)	
Others	8 (15.7)	3 (11.1)	

Table 1: Characteristics of patients, duration of anesthesia and indications of procedure (mean, SD and percentage).

	Group DS (n=51)	Group GA (n=27)	P value
Success rate	50 (98.0)	27 (100.0)	0.464
Propofol (mg/kg)			
N (%)	51 (100.0)	27 (100.0)	
Mean (SD)	3.7 (1.8)	2.9 (2.8)	0.150
Fentanyl (mcg/kg)			
N (%)	49 (96.1)	26 (96.3)	
Mean (SD)	1.0 (0.2)	1.0 (0.3)	0.447
Midazolam (mg/kg)			
N (%)	51 (100.0)	0	
Mean (SD)	0.09 (0.16)	0	

Table 2: Success rate and sedative agents used in both groups.

	Group DS (n=51)	Group GA (n=27)	P value
Overall complication rate	19 (37.3)	4 (14.8)	0.039*
Sedation related complication	18 (35.3)	4 (14.8)	0.056
Respiratory system	4 (7.8)	0	0.135
Hypoxia	1 (2.0)	0	0.464
Upper airway obstruction	3 (5.9)	0	0.199
Cardiovascular system	14 (27.5)	4 (14.8)	0.208
Hypotension	11 (21.6)	3 (11.1)	0.252
Bradycardia	3 (5.9)	0	0.199
Tachycardia	0	1 (3.7)	0.167
Procedure related complication			
Bleeding	1 (2.0)	0	0.464
Anesthetic personnel			0.315
Residents	28 (54.9)	18 (66.7)	
Anesthetic nurses	23 (45.1)	9 (33.3)	
Mortality rate	0	0	1.000

Table 3: Overall complication rate, sedation and procedure related complication, anesthetic personnel and mortality rate (n, %).

population. In addition, our practice will help model the development of anesthesia and sedation for pediatric EGD in the endoscopy unit outside the operating room in tertiary care hospital in developing country.

EGD procedure in children is an important and effective tool for the diagnosis and treatment of upper gastrointestinal abnormalities. The indications for upper endoscopy in the pediatric age group are similar to those for adult endoscopy [5]. These procedures are generally performed either with DS in the endoscopy room, or under GA in the operating room [6]. The decision to use GA is usually based on the patients' parameters such as age, diagnosis, respiratory compromise and severity of disease [7]. In some centers, GA is used on all infants, children and adolescents [7,8]. However, in other centers, DS is used for the procedures. With DS, several medication combinations have been used successfully [2,6,9].

In Thailand where pediatric EGD procedure performed at increasing rates, the majority of cases are performed under GA in the operating room. At Siriraj Hospital, there is a dedicated endoscopy unit with dedicated anesthesia service. Generally, the authors usually performed DS for EGD in healthy pediatric patients. We followed the guidelines provided by the American Academy of Pediatrics and American Academy of Pediatric Dentistry and ASA standards for sedation providers [4,10]. However, most anesthesiologists in our hospital commonly performed GA with endotracheal tube for EGD procedure in sick children. Our review of anesthesia practice in pediatric population showed that DS can be done safely with various sedative combinations with proper monitoring and anesthesiology service supervision.

Most patients in group DS received propofol in combination with fentanyl and midazolam. The use of propofol in pediatric population has been shown to be safe, effective and reliable [11,12]. Sedation with propofol is usually administered by anesthesiologists [7]. Desirable properties of propofol for endoscopic procedures include ease of use, quick onset of action, and rapid metabolization leading to shorter recovery time [13,14]. In addition, propofol-based sedation for various endoscopic procedures does not increase rate of complications even in sick patients [15-19]. Fentanyl is a potent synthetic opioid. It has a rapid onset, short duration of action, lack of direct of myocardial depressant effects, and absence of histamine release. Because of its potency, hemodynamic stability, and brief duration of action in small doses, fentanyl is an attractive analgesic for short procedures [20]. Midazolam is the drug most commonly used for sedation in children during procedures [21-23]. The authors usually use low dose midazolam in combination with other sedative agents.

Balanced anesthesia technique is a GA technique that consists of the combination of opioid, inhalation agent and muscle relaxant drug [24]. GA is ordinary used for painful or complicated endoscopic procedures. However, some anesthesiologists often used GA with endotracheal tube for pediatric EGD even in non-sick children. Compared to GA, the combination of propofol, fentanyl and midazolam seems to be an equally effective technique for selected patients of diagnosis and therapy. However, there is a considerable risk that DS with this regimen may result in an actual sedation depth close to GA with an increased risk. The result of our study supported this issue. Overall complication rate in group DS was significantly higher than in group GA. However, DS could be safely done by an experienced anesthesiologist. Sedation related-complications in both groups were comparable.

ASA physical status III-IV has been shown to be a predictor of increased risk for adverse sedation-related events [25]. Cardiopulmonary complications account for more than half of the major complications during endoscopy, and are often related to hypoxia, especially in children less than 1 year old [26,27]. The type of anesthetic technique is likely to be a predictor of increased risk for sedation-related adverse events. In our study, the overall complication rate in group DS was 37.3% and 14.8% in group GA. However, the serious adverse events was occurred only one patient in group DS and none in group GA.

This study shows that DS and GA for pediatric EGD in the endoscopy room in the developing country can be done safely and successfully. We believed that this success is because of two factors: dedicated anesthesia service involved with sedation and the use of basic non-invasive monitoring, which includes non-invasive blood pressure monitoring, pulse oximetry, and electrocardiogram. EGD procedure was done by an experienced pediatric endoscopist, and the anesthesia/sedation was performed by an experienced anesthesiologist. This practice is different when compared to the community hospital where most pediatric endoscopic procedures are being performed in the operating room with GA.

Our study has several limitations. The present study is a retrospective review of a cohort of patients undergoing pediatric EGD in sick patients. We accept that there are limitations with chart review in regards to proper and complete documentation. There is also a small sample size. Moreover, our practice employed only basic monitoring which does not include the use of end-tidal CO_2 for ventilation monitoring in group DS. Thus, respiratory adverse events may be underestimated. Overall, even with these limitations, we believe that

the study findings are applicable to the anesthesia practice for pediatric EGD procedure outside the operating room in sick children.

In summary, in a WGO Endoscopy Training Center in Thailand, DS and GA for pediatric EGD procedure can be safely and effectively performed in the endoscopy unit outside the operating room with a multi-drug regimen utilizing anesthesiologist with appropriate basic monitoring.

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