A Comparative Analysis of the Effects of Etomidate and Propofol for Inducing Sedation in Pediatric Patients Undergoing Upper Gastrointestinal Endoscopy

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Abstract

Introduction: Gastrointestinal endoscopy is a prevalent diagnostic and therapeutic procedure employed for both children and adults. Since Etomidate is a short acting intravenous drug with hemodynamic stability and also it is the choice for sedation and anesthesia among patients afflicted with cardiovascular conditions, we decided to compare the benefits and drawbacks of the mentioned drugs in children undergoing endoscopy.

Materials and Methods: For conducting the research, 90 pediatric participants, aged from 1 to 15 years, with ASA I and II class requiring upper gastrointestinal endoscopy (admitted to Mofid Children Hospital) were randomly

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selected. For 45 patients, intravenous anesthetic drug Propofol (Group P) was administered for sedation required during endoscopy, while in the remaining 45 patients, Etomidate (Group E) was used, and hemodynamic fluctuations, apnea occurrence frequency, sedation recovery length, and nausea and vomiting after sedation were monitored and compared between the two groups. Finally, the data were analyzed using SPSS v.18 software, and t-test and chi-square statistical tests.

Results: The average age of the patients was 7.8 ± 7.9 years. The recovery following anesthesia in Group P was 8.3 ± 4.3 minutes, while in Group E, it was 7 ± 3.2 minutes (p=0.373). The reduction in SPO_2 levels in Group P was 7.1 ± 3.9%, and in Group E, it was 1.4 ± 0.6% (p=0.01). The variations in heart rate (HR) were 3.9 ± 7.1 in Group P and 0.6 ± 1.4 in Group E (p=0.01). Changes in blood pressure (BP) were 10.1 ± 7.9 mmHg in Group P and 2.7 ± 1.3 mmHg in Group E (p = 0.235). The incidence of apnea was 26.7% (12 individuals) in Group P and 46.7% (21 individuals) in Group E (p=0.02). The occurrence of nausea and vomiting was 4.4% (2 individuals) in Group P and 20% (9 individuals) in Group E (p=0.01).

Conclusion: The result of the findings suggests that the patients receiving Etomidate experienced lower saturation drop, and quicker awakening compared to the group of patients receiving Propofol, while the occurrence of apnea, nausea, and vomiting were higher.

Keywords

- Pediatric Endoscopy
- Propofol
- Etomidate
- Intravenous Sedation

Introduction

Gastrointestinal endoscopy serves as an efficacious diagnostic and therapeutic procedure for the management of gastrointestinal ailments.[1] Given its non-traumatic yet invasive nature, it frequently elicits sensations of discomfort, nausea, vomiting, throat bleeding, and anxiety. Consequently, sedation becomes imperative for its execution.[2-3] Administering intravenous medications during gastroscopy can mitigate suprahyoid airway reflexes, thereby enhancing patient comfort.[4] Nonetheless, the practice of sedation in this context may lead to certain side effects, including delayed recovery, prolonged discharge time, hemodynamic instability, and an elevated risk of cardiovascular complications.[5-6] With the evolution of anesthesia for endoscopy, Propofol has gained widespread use in outpatient surgeries and interventions. It exerts a pronounced depressive effect on pharyngeal reflexes, featuring a rapid onset and swift recovery. However, it may induce cardiovascular depression, alter respiratory parameters, and compromise protective reflexes.[7-8] Etomidate, an imidazole derivative that acts on gamma-aminobutyric acid receptors,[9] offers a swifter onset, a broader safety margin compared to Propofol, particularly in patients with valvular heart disease, cardiac ischemia, and advanced age,[10] and imparts greater hemodynamic stability.[11] For years, Etomidate has found utility in procedural sedation in emergency rooms.[12] One side effect of Etomidate is the transient inhibition of cortisol synthesis, which limits its use in critically ill patients.[13] However, a 2007 study in Finland revealed that cortisol levels did not significantly differ from those of the control group the following morning.[14] Another study in 2015 indicated that this suppression persisted for approximately 24 hours and did not result in significant clinical outcomes.[15] Two additional side effects of Etomidate include myoclonus, which resolves spontaneously,[16] and nausea and vomiting.[17] A significant advantage of Etomidate over Propofol lies in its maintenance of hemodynamic stability. Etomidate does not suppress the autonomic nervous system or cardiac contractile function, rendering it a preferred choice in patients with cardiac conditions.[18] This medication exerts minimal effects on heart rate and blood pressure and is considered safe for patients with valvular and cardiac diseases. Furthermore, it imparts fewer respiratory effects compared to Propofol.[19]

and its recovery time is shorter than that of Propofol.[20] Concerning the use of Etomidate in children, its rapid onset (15-5 seconds) and short duration of action (15-10 minutes), along with minimal respiratory and hemodynamic side effects, have rendered it a suitable option for pediatric sedation.[21] A 2014 study conducted by Mahajan et al. in India reported Etomidate to be more effective and appropriate for pediatric sedation compared to pentobarbital and midazolam, finding it to be as safe as Propofol.[22] Given the paramount importance of cardiovascular stability in children, especially those with significant cardiovascular and pulmonary conditions, our study aimed to identify a method for stabilizing cardiovascular and respiratory parameters in patients with minimal potential side effects.

Materials and Methods

Upon obtaining approval from the ethical committee and written consent from parents, along with the assignment of an IRCT code, this research commenced in 1399 within the endoscopy department of Mofid Children Hospital. A total of 90 pediatric participants, aged between 1 and 15 years, classified as ASA I and II, necessitating upper gastrointestinal endoscopy, were randomly allocated into two groups of 45 participants each (group P, administered Propofol, and group E, administered Etomidate). Exclusion criteria encompassed a history of drug allergies to Propofol or Etomidate, kidney and liver diseases, adrenal disorders, severe pneumonia, prior ICU admissions, and a history of postoperative nausea and vomiting (PONV) or glucose-6-phosphate dehydrogenase (G6PD) deficiency. In both groups, a clinical examination and consent form were initially conducted by a pediatric gastroenterologist and an anesthesiologist. Subsequently, ECG, pulse oximetry, and blood pressure monitoring were performed, and baseline values were documented. Venipuncture was then carried out in either the mother's or father's arm, followed by the administration of 0.1 mg/kg intravenous midazolam to both groups as premedication. A 0.5 mg/kg dose of lidocaine was administered, succeeded by a 1 mg/kg dose of Propofol in group P and a 0.1 mg/kg dose of Etomidate in group E. Incidences of pain at the injection site were recorded, and after the child achieved sedation, they were positioned laterally for

endoscopy, and nasal oxygen was supplied at a rate of 4 liters per minute. Blood pressure, heart rate, and oxygen saturation levels were recorded one-minute post-anesthetic injection and subsequently every five minutes. In the event of patient arousal, 1 mg/kg of Propofol or 0.1 mg/kg of Etomidate was re-administered, with the number of re-administrations documented in the checklist. Incidences of laryngospasm and apnea were also recorded. After completion of the endoscopy, sedation awakening time, occurrences of nausea and vomiting post-sedation, and the child's restlessness were documented in the checklist. Random sampling in each group was performed using a

random number table to ensure blinding of the study. The recording of events and questionnaire completion was conducted by an anesthesiologist assistant, while drug administration was performed by an anesthesiologist who was unaware of the type of drug being administered. Data collected was then input into SPSS version 18. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were employed to characterize qualitative and quantitative variables. Relationships between variables were assessed using the T-test, One-way Anova, and Chi-squared tests, with regression modeling utilized to control for confounding variables.

Result

The average patient age was 7.8 ± 7.9 years. The study revealed that the mean age in group P was 8.3 ± 4.3 years, while in group E, it was 7.0 ± 3.2years, demonstrating no significant difference between the groups (P=0.373). Additionally, it was observed that the awakening time in group P (8 ± 3.2 minutes) exceeded that in group E (6 ± 40 minutes), with statistical significance (P=0.04).

Furthermore, the findings of this study indicated that the SPO_2 drop following awakening in group P (7.1 ± 3.9 percent) was significantly higher than in group E (-1.4 ± 0.6 percent) (P=0.01). Heart rate variation in group P amounted to 3.9 ± 7.1, while in group E, it was 0.6±1.4, exhibiting no significant difference (P=0.056).

Similarly, blood pressure variations in group P were measured at 10.1± 7.9, and in group E, they were 2.7± 1.3, with no statistically significant difference (P=0.235) **(Table 1).**

Notably, the incidence of apnea in patients receiving Propofol (26.7%) was lower than in those receiving Etomidate (46.7%), with this difference proving statistically significant (P=0.02). Furthermore, the occurrence of nausea and vomiting in group P patients was 4.4%, while in group E, it was 20%, representing a statistically significant difference (P=0.01) **(Table 2).**

Table 1: Characteristics of patients involved in the study.

Variable	Propofol group	Etomidate group	P-value
Age	3 ± 4/ 3 8/	2 ± 3/ 0 7/	373 0/
Awakening Time	3 ± 00/ 7 00/	2 ± 2/ 6 2/	04 0/
SPO2 variations	0 ± 5/ 9 6/-	8 ± 2/ 0 2/-	00 0/
HR variations	0 ± 7/ 9 3/	4 ± 0/ 6 0/	056 0/
BP variations	2 ± 00/ 8 7/-	9 ± 7/ 0 00/-	235 0/

Table 2: Comparison of apnea and nausea and vomiting in two groups

Variable		Propofol group	Etomidate group	Table 2. Comparison of apnea and nausea and vomiting in two groups **P-value**
Apnea	observed	21(46.7%)	12(26.7%)	0.02
	was not observed	33(73.3%)	24(53.3%)	
Nausea and Vomiting	observed	2(4.4%)	9(20%)	0.01
	was not observed	43(95.6%)	36(80%)	

Discussion

The findings of the current investigation reveal noteworthy insights into the administration of Etomidate and Propofol for sedation during pediatric endoscopy. Specifically, the study demonstrates that the reduction in sedation depth and awakening time in patients receiving Etomidate was significantly lower in comparison to the Propofol group. However, it is crucial to note a significant disparity in the incidence of apnea and nausea/vomiting, with a higher frequency observed in the Etomidate group. Furthermore, alterations in heart rate and blood pressure were noted to be comparable between both groups.

Most previous studies have consistently reported a more pronounced decline in blood pressure associated with Propofol, as opposed to Etomidate. Notably, a study by Limin Ye et al. in China in 2017 investigated the effects of Etomidate versus Propofol for anesthesia induction during endoscopy. In their research, among 465 patients in the Etomidate group, 20 patients experienced a decrease in blood pressure, in contrast to 75 patients out of 470 in the Propofol group, indicating a substantial difference with fewer incidents in the Etomidate group. Additionally, the study observed occurrences of apnea or hypoxia

in 62 patients out of 465 in the Etomidate group and 119 patients out of 470 in the Propofol group, diverging from our findings where the incidence of apnea was higher among patients receiving Etomidate.[3]

In a study conducted by Su Jung Han and colleagues in South Korea in 2018, where 186 patients underwent sedation for endoscopic procedures and were divided into Propofol and Etomidate groups, the research concluded that adverse cardiac and respiratory events occurred less frequently in the Etomidate group compared to the Propofol group, emphasizing the safety of Etomidate usage in patients. Furthermore, the study indicated fewer hemodynamic fluctuations in patients receiving Etomidate, with no significant variance in gastrointestinal discomfort, including nausea and vomiting, between the two groups. Additionally, other adverse events, such as pain at the injection site, did not exhibit significant differences between the two groups.[17]

Similarly, in a study by Jin-Chao Song and colleagues in Shanghai, China, in 2015, 80 patients undergoing ERCP were randomly assigned to Etomidate and Propofol groups. The results demonstrated a significantly lower reduction in MAP in the Etomidate group compared to the Propofol group. In contrast to our findings, where recovery time was shorter with Etomidate, no notable disparity in recovery time was observed between the two groups.[11]

In a study conducted by S. Bendel and his colleagues in Finland in 2006, including 66 patients with severe aortic stenosis undergoing aortic valve replacement surgery, the patients were divided into two groups, one receiving Propofol and the other Etomidate for induction. The results indicated that the Propofol group reported more instances of blood pressure decline than the Etomidate group, with a greater number of patients in the Propofol group requiring phenylephrine to increase blood pressure.[14]

Furthermore, several studies in this field have explored the combined use of Propofol and Etomidate. For instance, in a meta-analysis by Chen and colleagues in 2019, it was found that the combination of Propofol and Etomidate may lead to an extended recovery time compared to Propofol administered alone. Nevertheless, it exhibited fewer adverse effects on blood circulation and respiration in patients undergoing endoscopy. This combination was shown to enhance and mitigate the adverse effects of Propofol or Etomidate

when used individually, rendering it a safer and more effective approach than employing them individually.[23]

Additionally, a study conducted by Liu and colleagues in 2021 concluded that the concurrent administration of Etomidate with Propofol may reduce the risk of MAP decrease, sedation depth, high myoclonus, apnea, or hypoxemia induced by Propofol. It may also decrease the likelihood of high myoclonus and prolong recovery time linked to Etomidate.[24]

Moreover, a study by Qing-Tao Meng and colleagues categorized patients into four groups: Propofol, Etomidate, Propofol induction followed by Etomidate continuation, and Etomidate induction followed by Propofol continuation. The study results revealed a significant difference in the incidence of hypotension in the Propofol group, with better thermodynamic stability observed in the three groups compared to the Propofol group alone.[10]

Conclusion

Drawing upon the findings of this present research and the extensive body of prior studies, it is evident that both Etomidate and Propofol are safe and efficacious medications for inducing sedation in pediatric patients undergoing endoscopy. Notably, these drugs contribute to cardiac hemodynamic stability following the awakening phase, which holds paramount importance in pediatric patients. Accordingly, it is advisable to consider the concurrent administration of these drugs. Nevertheless, it is vital to acknowledge that the incidence of apnea and nausea/vomiting was significantly higher in the Etomidate group. Consequently, it is recommended that the anesthesia team exercise heightened caution when employing Etomidate for pediatric endoscopy sedation, with the aim of mitigating these adverse effects effectively.

Ethical Consideration

This study received ethical code from the ethical committee of Shahid Beheshti university of medical sciences (IR.SBMU.RICH.REC.1399.036).

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Conflict of interests

There is no conflict of interest

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