Original Paper

Comparative Study of Moderate Sedation with Propofol Versus Propofol Combined with Midazolam for Ambulatory Care Digestive Endoscopic Procedures

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ABSTRACT: Anesthesia is essential during colonoscopy because it provides patients with necessary sedation to perform the investigation safely and nonetheless to obtain the highest quality of the results. We aimed here to evaluate and establish which of the combinations of anesthetic drugs most frequently used for sedation purposes for gastrointestinal endoscopic procedures performed in the ambulatory best covers the needs of the patient and the gastroenterologist. This is a prospective, randomized, double-blind study carried out on a total of 100 patients, aged between 18 and 80 years, who meet the conditions for inclusion in the study. Patients were randomly allocated into either group A (Propofol) or group B (Midazolam plus Propofol). Evaluation of the dose of Propofol used in the 2 groups, awakening time, anesthetic induction, as well as the occurrence of episodes of bradycardia and hypotension represented the parameters followed in the study. In group A, 50 patients received on average 218.6mg of Propofol in bolus of 10-20mg. In group B, 50 patients received 0.1mg/kg Midazolam and an average of up to 129.2mg of Propofol in bolus of 10-20mg. Awakening time was shorter in group A-3.18 minutes, than in group B-15.7 minutes. Bradycardia and hypotension were met in a larger number in group B than in group A. The quality of the endoscopic evaluation was similar in both groups. The conclusion of our study was that the group to which only Propofol was administered had the best results from all aspects (rapid anesthetic induction, stability of vital functions, lower cost, awakening time much faster) compared to the combination of Propofol with Midazolam.

KEYWORDS: *Propofol, drug combination, gastrointestinal endoscopic procedures, ambulatory.*

Introduction

In 1937 "the digestive tract was inaccessible and not being seen except for its top and bottom" (Sir Avery Jones, 1987) [1].

Thanks to technical and scientific progress, this has changed.

Now not only can the digestive tract be visualized for the diagnosis of its ailments, but also different therapeutic procedures can be performed (biopsy sampling, polyp resections, etc.) [1-3].

The emergence of guidelines and protocols, as well as the progress made in anesthesia and intensive care, have allowed the use of various hypnotic, sedative, analgesic drugs in digestive endoscopic procedures with the aim of reducing patient anxiety and discomfort [4,5].

The main objectives of a superior anesthetic colonoscopy and endoscopy performed under sedation, on ambulatory care, are the following: fast and good quality narcosis, analgesia, amnesia, maintaining the stability of vital functions, increased comfort for the patient and the gastroenterologist, and fast recovery time awakening and discharge [6-9].

In this research, it started from the fact that there is still no universally accepted anesthetic protocol for the moderate sedation of patients undergoing gastrointestinal endoscopy performed in the ambulatory, which covers the desired outcomes of the medical act.

An adequate level of sedation allows a thorough endoscopic exploration which is desirable for the successful performance of a safe and high-quality colonoscopy and gastroscopy [10-14].

Materials and Methods

The reference study was carried out at the Gastroenterology and Hepatology Research Center, University of Medicine and Pharmacy, Craiova, over a period of 5 months, from March 2022 to August 2022, using various anesthetic drugs alone or in different combinations, in order to perform upper and lower digestive endoscopy.

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The study is extensive and is part of a research work that is carried out over several years.

Since the research was carried out in ambulatory conditions, we considered that the patients with associated organic affections should be well evaluated and their vital functions compensated at the time of exploration.

Therefore, we established as exclusion criteria: women with ongoing pregnancy, patients included in the American Society of Anesthesiologists (ASA) IV anesthetic risk score, patients who refused to participate, patients with an incomplete and incorrect preparation of the digestive tract, patients with organic insufficiency decompensated, known allergies to Propofol or Midazolam [15].

We formed 2 study groups, namely group A containing 50 patients, 27 men and 23 women, who underwent 7 gastroscopies, 30 colonoscopies and 13 mixed explorations, using Propofol sedation.

Group B also contains 50 patients, of whom 36 men and 14 women, in whom 3 upper endoscopies, 34 lower endoscopies and 13 both upper and lower ones were performed, whose sedation was achieved through the combination of Propofol with Midazolam (Figure 1).

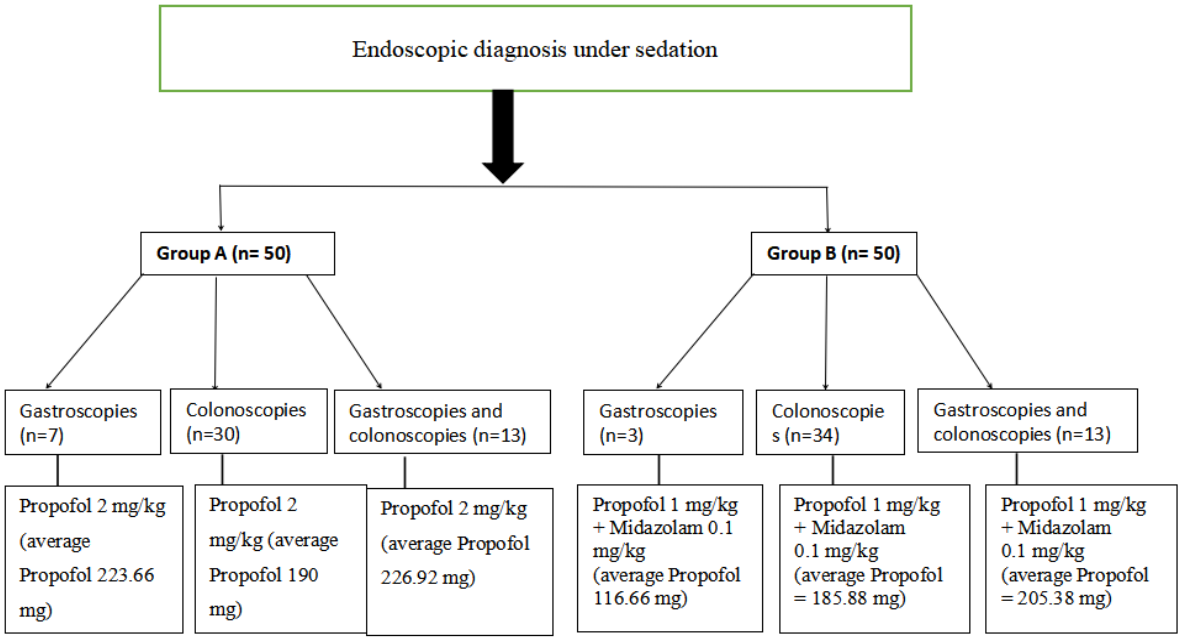

Figure 1. Sedation protocol for the average Propofol used in the two groups.

Of the total number of explorations, a number of 11 were performed for diagnostic purposes and 39 for the screening of gastrointestinal pathologies, in the group with Propofol.

On the contrary, in the group with Propofol combined with Midazolam 19 of the patients included in the study performed investigations with a diagnostic purpose and 31 for screening.

Patients were randomly assigned to one of 2 groups.

The administration of Propofol and Midazolam was carried out by a nurse under the strict supervision of the anesthesiologist.

The patients in group A were administered a dose of 2mg/kg Propofol slowly intravenously, followed by the re-injection of 20mg (2ml solution) every time we noticed a superficialization of the anesthetic sleep (awakening reaction, heart rate increase by 15-20% compared to initial values, blood pressure increase by 15-20% compared to initial values).

The patients in group B were initially administered a dose of 0.1mg/kg Midazolam followed by 1mg/kg Propofol intravenously until anesthetic sleep was established, and if necessary, the re-injection of 20mg (2ml solution) Propofol if signs of superficialization of anesthetic sleep appeared.

All patients received, 30 minutes before the start of the digestive endoscopic procedure, a vial of Scopolamine butyl bromide intravenously.

Monitoring of vital parameters (blood pressure, heart rate, peripheral oxygen

saturation) was performed using the **General Electric B125 VSP 2.0.** monitor.

The gastrofibroscope and colonoscope used throughout the study was an **Olympus X1 CV 1500 CF-EZ1500DL 3.7** type.

During the entire intervention, the patients benefited from a nasal cannula for the administration of concentrated humidified oxygen at a flow rate of 4-6L/min to prevent the occurrence of possible hypoxic episodes.

We had at our disposal the resuscitation kit of the Gastroenterology Research Center and a Datex-Ohmeda Aespire anesthesia machine.

The parameters followed in order to monitor the evolution of the patient during the gastrointestinal endoscopic procedures were:

- Vital parameters: BP (blood pressure), HR (heart rate), SpO_2 (peripheral oxygen saturation).
- Duration of the endoscopic procedure: for gastroscopies the time elapsed from the insertion of the endoscope until withdrawal, and for colonoscopies from the insertion of the colonoscope until the visualization of the ileocecal valve, plus the withdrawal time from the ileocecal valve to the extraction of the endoscope, which can be increased to patients who also undergo therapeutic procedures (polypectomies, biopsies).
- Awakening: it is defined as the time interval elapsed from the complete withdrawal of the endoscope to the moment when the patient is fully conscious, cooperative, time-space oriented.
- Discharge: it was achieved when the sum of the parameters of the Aldrete score for the evaluation of the quality of awakening from anesthesia reached a score of 10 units for each patient [16,17].

All patients benefited during the intervention from the administration of an intravenous infusion with 0.9% NaCl saline solution.

The patient was monitored throughout the investigation, from the moment he was placed on the table until he completely woke up from anesthesia and was discharged to the room.

It was assessed that the endoscopic procedure can begin when the patient's ciliary reflex has disappeared, the state of anesthetic sleep has set in, there is no reaction to the insertion of the endoscope and the patient is respiratory and hemodynamically stable [18].

During recovery patients completed a satisfaction questionnaire, to be discharged when the Aldrete score reached 10 units and with the instruction not to drive for 6 hours after awakening from anesthesia.

All collected data were recorded in an anonymized electronic database consisting of Excel spreadsheets (Microsoft, USA).

The study was approved by the local Ethics Committee of the University of Medicine and Pharmacy of Craiova and were in line with the Helsinki Declaration.

Statistical Analysis

The statistical analysis of the obtained data was carried out using an Excel (Microsoft, USA) and MATLAB (Mathworks, USA).

The significance level was set to 0.05 for the study.

All numerical data were tested to assess the normality distribution using Lilliefors test, Lilliefors distribution (right-tailed).

Since the p-value<0.05, we reject the null hypothesis and assumed that the data distribution is not normal.

Hence, non-parametric Mann-Whitney for two samples was used for mean comparisons.

Categorical data were assessed using the chi-square statistics.

Results

We examined a total of 100 patients subjected to moderate sedation with Propofol or the Propofol+Midazolam combination for the purpose of gastrointestinal endoscopies.

The average age in the group of patients sedated with Propofol was 56.78 years, and in the group with Propofol combined with Midazolam 57.62 years (Figure 2), with a male predominance in both study groups, highlighted in the graph below (Figure 3).

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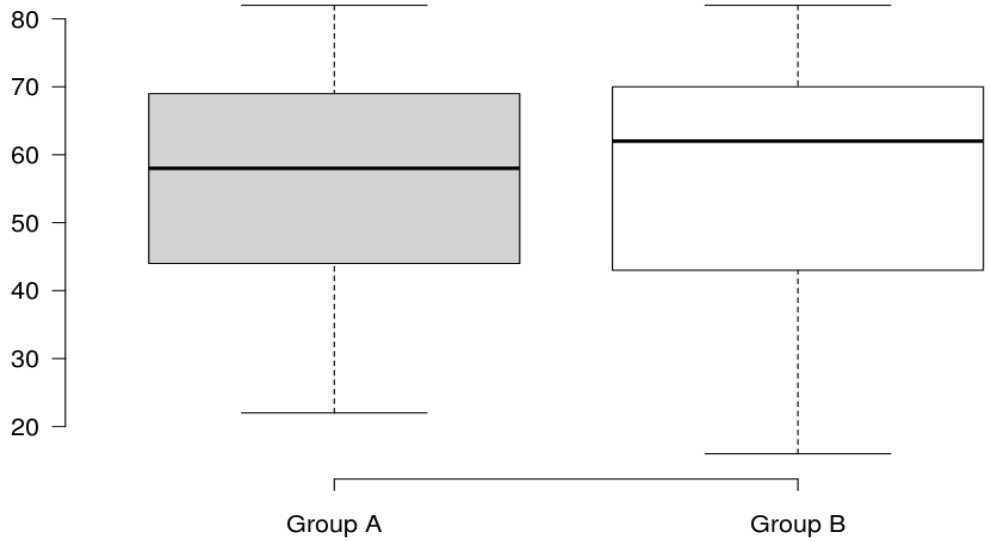

Figure 2. The average age of the two groups.

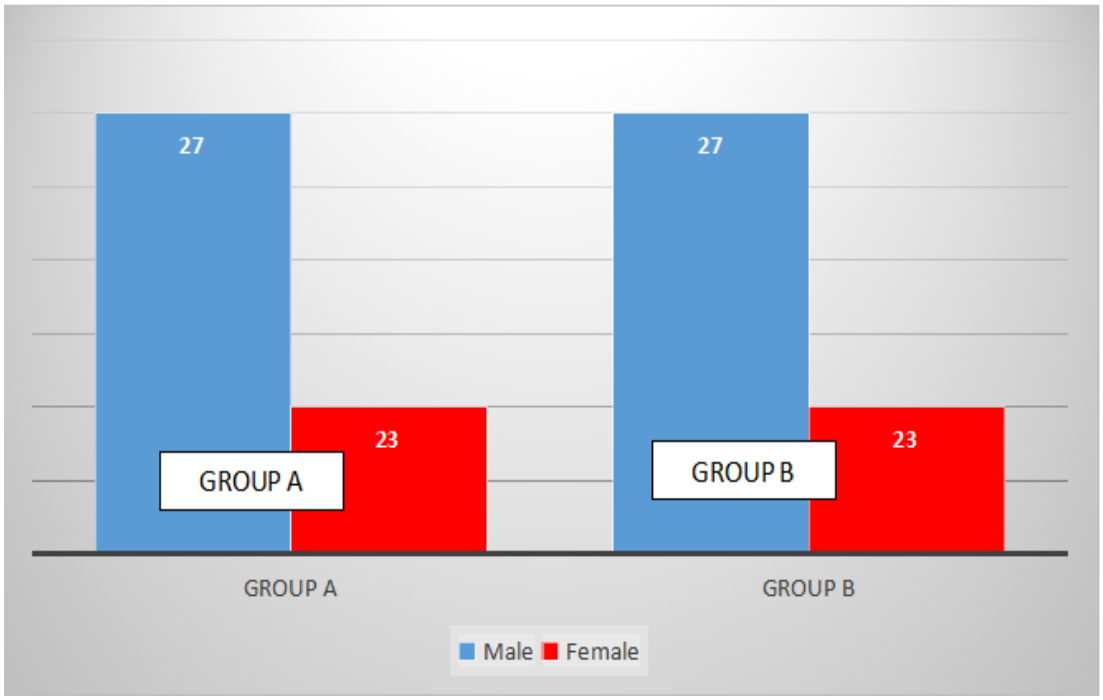

Figure 3. Gender distribution of the studied patients.
The chi-square statistic is 0. The p-value is 1. The result in not significant at p<0.05.

The most common symptoms for which the patients opted for the endoscopic investigation were represented by: abdominal pain, transit disorders (diarrhea, constipation), rectal bleeding, anemia of unspecified etiology, signs of neoplastic impregnation, illustrated in the figure below (Figure 4).

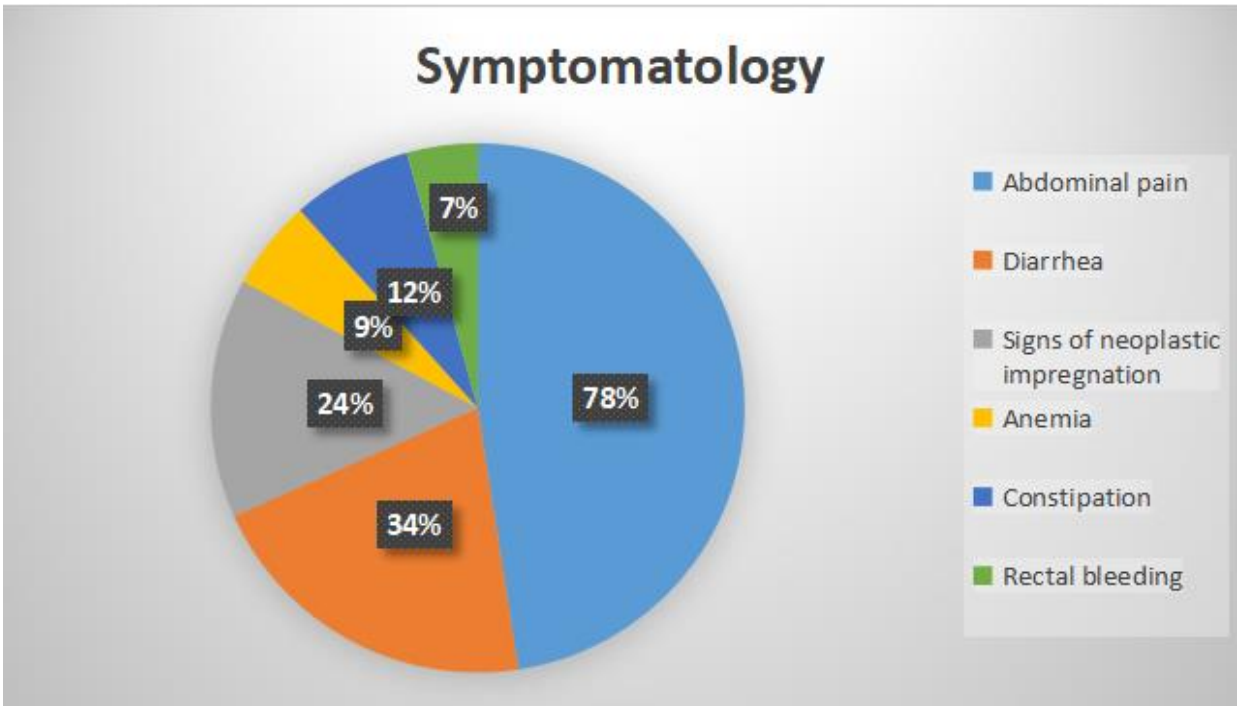

Figure 4. Symptomatology in endoscopically explored patients.

The preparation of the patients was carried out 24 hours before the exploration and consisted of the administration of 4 sachets of Fortrans (polyethylene glycol) diluted in 4 liter of water, 3 liter being administered the day before the procedure and 1 liter 5 hours before the patient's presentation in the outpatient clinic. 3% of patients presented with an incorrectly prepared digestive tract, but we note that all other scheduled patients benefited from endoscopic exploration.

Taking into account the ASA score, patients who were evaluated as having an ASA I, ASA II and ASA III A score were selected, according to Figure 5.

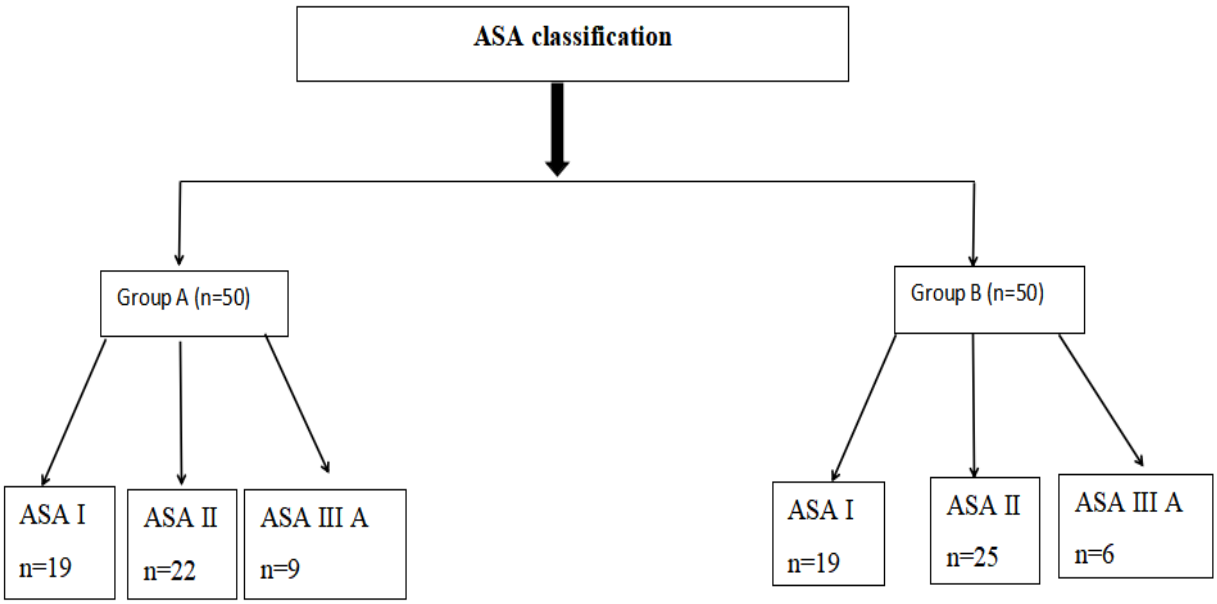

Figure 5. ASA classification of endoscopically explored patients.

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The incidence of the most common diseases that required endoscopic exploration, taking into account the patient's age and sex, is recorded in Table 1 as follows:

Table 1. Group A-represents the group to which Propofol was administered. Group B-the group that received Propofol+Midazolam.

	Group A (n=50)	Group B (n=50)
Age	56.78	57.84
Male gender	54%	56%
Abdominal pain	76%	82%
Inflammatory Bowel Disease	26%	20%
Anemia of unknown etiology	8.7%	9.4%
Colon polyps	10%	10%
Signs of neoplastic impregnation	21.2%	19.4%

Regarding the average doses of Propofol administered to patients, Figure 6 illustrates the comparison by batch.

The total dose of Propofol used in patients in group A was 218.6mg, and in group B the dose of Propofol was significantly lower, with an average of 129.2mg.

The time required to install the anesthetic sleep was shorter in group A (14 seconds) than the time recorded in group B (64 seconds) (Figure 7).

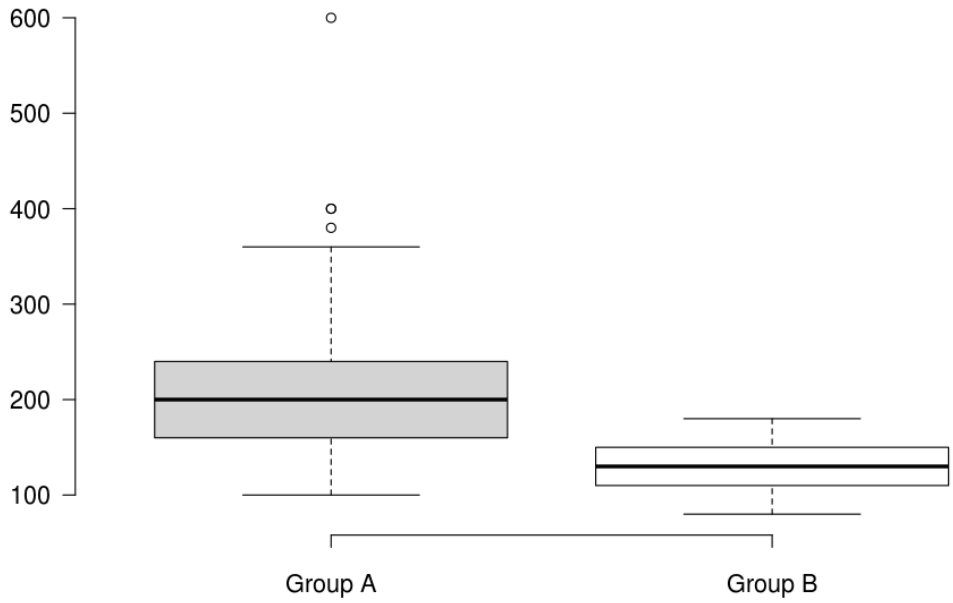

Figure 6. Average dose of Propofol in the two groups, values in mg. Mann-Whitney's test p-value is <0.00001. The result is significant at p<0.05.

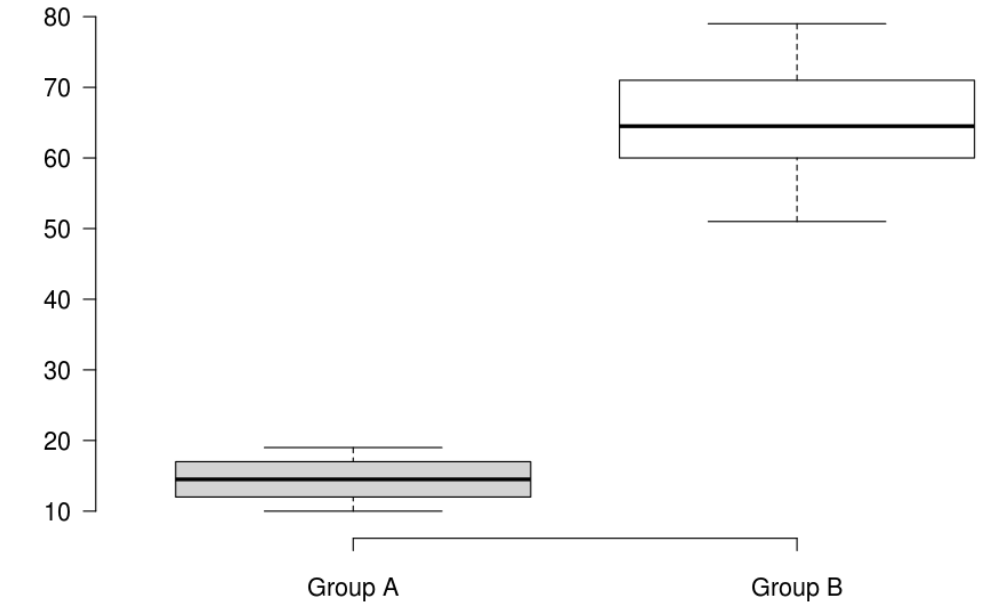

Figure 7. Anesthetic induction in Propofol versus Propofol plus Midazolam, in seconds. Mann-Whitney's test p-value is <0.00001. The result is significant at p <0.05.

The awakening time was much lower in group A where sedation was performed with Propofol, with an average of 3.18 minutes, compared to group B where the combination of anesthetic drugs was used and the average was 15.7 minutes (Figure 8).

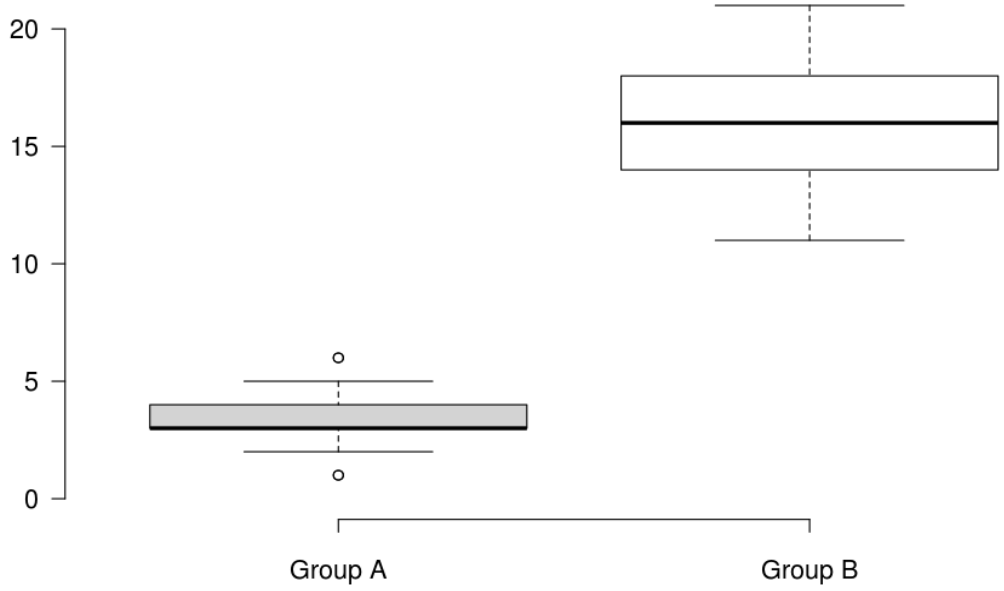

Figure 8. Wake-up time, in minutes. Mann-Whitney's p-value is <0.00001. The result is significant at p<0.05.

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The digestive tract could be completely visualized in all cases.

The hemodynamic impact of drug administration was represented in Figure 9.

In group A patients, slight bradycardia was observed in 11 patients, and hypotension occurred in 19 studied patients.

In group B, there was an increase in the episodes of bradycardia and arterial hypotension compared to group A, but without impact on the general condition of the patient (Figure 9).

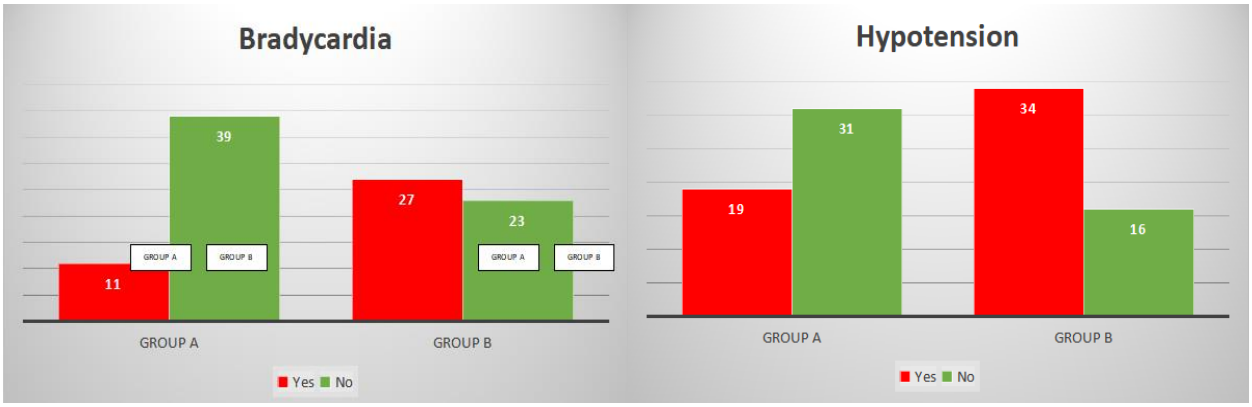

Figure 9. Cardiopulmonary complications: Bradycardia-The chi-square statistic is 10.8659. The p-value is 0.00098. The results is significant at p<0.05. Hypotension-The chi-square statistic is 9.0325. The p-value is 0.002652. The result is significant at p<0.05.

There was no need at any time of the interventions for ventilatory support of the patients, there were no episodes of cyanosis, hypotension and bradycardia were moderate, well tolerated, they did not require life support intervention, alteration of the general condition or patients transferred to Emergency Room.

So, the drugs used in sedation are safe and stable in terms of impact on patients' vital functions in short-term digestive endoscopic procedures.

Discussions

The world's population is aging at an accelerating rate. As a result, the number of elderly patients requiring endoscopic procedures for diagnostic and therapeutic purposes will increase significantly in the coming years.

At the same time, we also noticed an increase in the incidence of gastrointestinal pathology (inflammatory bowel disease, polyps, neoplasia) in young patients, aged between 20 and 40 years.

Endoscopic exploratory procedures are minimally invasive procedures that allow the direct visualization of lesions located in the digestive tract, their biopsy and diagnosis in order to establish the therapeutic attitude, as well as therapeutic interventions on polyps and other elements of digestive pathology.

Sedation is a drug-induced depression of the level of consciousness.

Today we benefit from anesthetic substances that can be used during digestive exploratory procedures in order to decrease the patient's anxiety and discomfort and to induce anterograde amnesia.

The level of sedation can vary depending on the patient and the duration of the procedure, and the dose of sedative must be titrated and adapted to the requirements of each case.

In the present study, a main objective was represented by maintaining the stability of the patients' vital functions during the procedure.

Thus, we evaluated the hemodynamic stability, spontaneous breathing, prevalence of hypertension/hypotension, bradycardia/tachycardia of each patient.

The collaboration with an Anesthesia and Intensive Care medical team that allowed sedation of patients throughout the procedures by using specific anesthetic drugs and monitoring vital functions, resulted in increasing patients' confidence in the medical act, leading to an increase in the number of cases explored and of addressability to the gastroenterologist [19].

In America over 98% of intestinal endoscopic procedures are performed under sedation [20,3,21].

The hemodynamic impact of the doses of anesthetics used is minimal, therefore the

possible incidents, accidents and complications induced by the use of drugs are null.

Moderate sedation is the ideal mode of anesthesia for patients undergoing endoscopic investigations [6,19,21].

Anesthesia strategies for gastrointestinal endoscopies have developed rapidly in recent years.

Propofol has been widely used for ambulatory intravenous sedation, with data in the literature suggesting its superiority over traditional sedatives used in endoscopies, such as opioids and benzodiazepines, but there are concerns about potential adverse effects [13,24,22].

Propofol is a safe and effective drug in terms of its action on the central nervous system.

It induces hypnosis in 10-20 seconds, has a short duration of action (10 minutes), produces amnesia and striated muscle relaxation to varying degrees, but has no analgesic effect [23,16,24,25].

Due to its structure and pharmacokinetic properties different from other anesthetic drugs, it is the ideal drug for moderate sedation [16,24].

Administered in repeated doses, Propofol can lead to different degrees of sedation and a prolongation of the time required waking up [26,24].

Propofol sedation achieved by controlled infusion is considered a safe administration option for patients with comorbidities, currently undergoing numerous research studies [27,28,29].

Instead, Midazolam is a benzodiazepine with a sedative effect that sets in relatively quickly (30-60 seconds), lasting 25-30 minutes (in sedative doses), water-soluble, which inhibits the central nervous system by specific binding to gamma aminobutyric acid receptors type A.

It has anxiolytic, sedative-hypnotic, anticonvulsant and anterograde amnesic properties [23,30].

The duration of sedation is correlated with the amount of drug administered, the sedation time can vary from 17 minutes to 80 minutes [23].

The most common side effects are hypotension, hypoxia and hypoventilation, exacerbated when Midazolam is combined with other drugs with a central nervous system depressant effect [31].

In order to assess the depth of anesthetic sleep, it would have been necessary to monitor the bi-spectral analysis index (BIS) of the EEG, which we did not have at the time of the study.

We expected that, by associating a benzodiazepine with Propofol in group B, the anesthetic sleep would have been deeper as a result of the cumulative effect of Propofol with Midazolam.

This was reflected in the speed of awakening, which was significantly higher in patients in group A (who only received Propofol) compared to those in group B where Propofol was administered with Midazolam.

In the Propofol and Midazolam group, a significantly lower dose of both drugs was used, with the rate of propofol adverse effects being much lower than in group A.

Being an anesthetic drug, the administration and monitoring of patients during advanced gastrointestinal procedures under Propofol sedation requires the presence of an Anesthesia and Intensive Care specialist.

The incidence of adverse cardiovascular effects, such as hypotension and bradycardia, was significantly higher in the Propofol/Midazolam group compared to the Propofol group, but none of the patients had permanent impairment of vital functions.

Therefore, the simultaneous use of Propofol and Midazolam in the study allows the reduction of doses and the achievement of a combined sedation with a lower requirement of each drug and implicitly with minimal side effects.

The Aldrete scale of awakening from anesthesia was 10 units for all patients, awakening from anesthesia was faster in group A (3.18 minutes) compared to group B (15.7 minutes) due to the residual sedative effect of benzodiazepines.

The average dose of Propofol in group A was 218.6mg, and in group B it was significantly lower (129.2mg) due to the combination with a benzodiazepine (values considered statistically significant).

Compared to the sedative use of Midazolam, regarding the satisfaction coefficient of benzodiazepine+Propofol, Propofol was better accepted by the examining physician because it signaled fast and good quality sleep throughout the procedure and quick awakening, the patients presented at the center, at the end of the procedure, they filled out a satisfaction questionnaire regarding the entire medical procedure (anesthesia+lower and upper digestive exploration), and 95% of them were very satisfied, and 5% felt pain.

Last but not least, the cost-procedure ratio proved to be more advantageous when Propofol was used alone due to the low price of one vial

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(7 lei per vial), using an average of 2 vials per patient, so that for a patient gastroendoscopically investigated the cost was much lower than in group B (17 lei per vial), where the price of the drugs used was higher, and implicitly the cost of the investigation was higher.

The following observations emerge from the research carried out

Propofol-administered as a single drug for short-term sedation in digestive exploratory procedures, generates its sedative effect rapidly (average 8-10-20 seconds), lasting approximately 10 minutes (after which it requires re-injection of a single dose of 20-25% of initial dose to maintain the sedative effect), with minimal impact on vital functions (effectively preserves spontaneous breathing, only moderate hypotension and bradycardia), with very quick awakening, maximum 5-10 minutes after the last administration (with perfect recovery of cognitive function) and obviously with low cost price.

Midazolam combined with Propofol-allows the use of small doses of the drug, the effect sets in more slowly, is deeper and lasts longer, and the cardiovascular and respiratory depressant effects are more pronounced, than in the case of using only Propofol, with the mention that the respiratory functions and cardiovascular are good and stable, with slower awakening and with a discreet residual sedative effect, but with a higher cost price.

Conclusion

Propofol in a dose of 2mg/kg used for moderate sedation during gastrointestinal endoscopy proved to be more effective in all aspects (rapid anesthetic induction, stability of vital functions evidenced by fewer hypoxic, bradycardic and hypotensive episodes, lower investigational cost small, awakening from anesthesia much faster) compared to the combination of Propofol with Midazolam.

Conflict of interests

The authors declared no conflict of interest.

References

1. K Gibinski, A Nowak, T Marek. Digestive endoscopy from rigid to fiber-optic instruments; the Polish contribution to the development of gastrointestinal endoscopy. J Physiol Pharmacol, 2003, 54 (Suppl 3):283-327.
2. Dayna Early S, Jenifer Lightdale R, John J Vargo J 2nd, Ruben Acosta D, Vinay C, Krishnavel Chathadi V, John Evans A, Deborah Fisher A, Lisa F, Joo Ha H, Mouen Khashab A, Raman Muthusamy V, Shabana Pasha F, John Saltzman R, Amandeep Shergill K, Brooks Cash D, John DeWitt M. Guidelines for sedation and anesthesia in GI endoscopy. Gastrointes Endosc, 2018, 87(2):327-337.
3. Shuang Y, Junpeng H, Tong S, Zhicong C, Yihua G, Chaoyang L, Youtan L. Efficacy and Tolerability of Sufenil, Dexamedetomidine, or Ketamine Added to Propofol based Sedation for Gastrointestinal Endoscopy in Elderly Patients: A Prospective, Randomized, Controlled Trial. Clin Ther, 2019, 41(9):1864-1877.
4. F M Reimann, U Samson, I Derad, M Fuchs, B Schiefer, E F Stange. Synergistic sedation with lowe dose of midazolam and propofol for colonoscopies. Endoscopy, 2000, 32(3):239-244.
5. Can-Xia X, Xiong C, Yan J, Ding-Hua X, Hui-Fang Z, Qin G, Fen W, Xiao-Yan W, Shou-Rong S, Ling-Ling T, Ke C, Xiao-Ming. Stepwise sedation for elderly patients with mild/moderate COPD during upper gastrointestinal endoscopy. World J Gastroenterol, 2013, 19:4791-4798.
6. Germano De Cosma, Elisabetta C. Is sedation for endoscopy as safe as you think? Minerva Anesthesiol, 2017, 83(11):1118-1120.
7. Chiung-Dan H, Jui-Mei H, Ya-Ping C, Hua-Yi W, Yu-Chung S, Jeng-Yih W, Wen-Ming W, Hung-Te H, Hui-Fang H, I-Cheng L, David Vi L. Propofol target-controlled infusion dor sedated gastrointestinal endoscospy: A comparision of propofol alone versus propofol-fentanyl-midazolam. Kaohsiung J Med Sci, 2015, 31(11):580-584.
8. Daorong W, Chaowu C, Jie C, Yaxiang X, Lu W, Zhen Z, Denghao D, Juan C, Aihua L, Dong T, Jun L. The use of propofol as a sedative agent in gastrointestinal endoscopy: a meta-analysis. PLoS One, 2013, 8:e53311.
9. Wen-Hung H, Sophie S W W, Hsiang-Yao S, Meng-Chieh W, Yi-Yu C, Fu-Chen K, Hui-Ying Y, Shun-Li C, Koung-Shing C, Kuang-I C, Deng-Chyang W, I-Cheng L. Low effect site-concentration of propofol target-controlled infusion reduces the risk of hypotension during endoscopy in a Taiwanase population. J Dig Dis, 2013, 14:147-152.
10. Fadi Abu B, Amir M, Kamal A, Abu Ras H, Barouch O, Yael K. Propofol sedation in colonoscopy: from satisfied pacients to improved quality indicators. Clinical and Experimental Gastroenterology, 2019, 12:105-110.
11. Rongzan Z, Quan L, Younong W. The comparision of Midazolam and Propofol in Gastrointestinal Endoscopy: A Systemic Rewiev and Meta-analysis. Surg Laparosc Endosc Percutan Tech, 2018, 28(3):153-158.

12. Baker SN, Weant KA. Procedural sedation and analgesia in the emergency department. J Pharm Pract, 2011, 24:189.
13. Limin Y, Xiangyang X, Liyi Z. The compatision of Etomidate and Propfol Anesthesia in Patients Undergoing Gostrointestinal Endoscopy: A Systematic Review and Meta-Analysis. Surg Laparosc Endosc Percutan Tech, 2017, 27(1):1-7.
14. Aureo Augusto de AD, Diogo Turiani, Igor Braga R. Propofol vs traditional sedatives for sedation in endoscopy: A systematic review and meta-analysis. World J Gastrointest Endosc, 2019, 11(12):573-588.
15. Julian Gomez L, Fuentes Coronel A, Lopez Ramos C, Ochoa Sangrador C, Fradejas Salazar P, Martin Garrido E, Conde Gacho P, Bailador Andres C, Garcia-Alvarado M, Rascarachi G, Castillo Trujillo R, Rodriguez Gomez SJ. A clinical trial comparing propofol versus propofol plus midazolam in diagnostic endoscopy of patients with a low anesthetic risk. Rev Esp Enferm Dig, 2018, 110(11):691-698.
16. Iurie Acalovschi. Capitolul 11: Anestezicele intravenoase. Anestezie clinică, ediția a II-a, Clusium, 2005, 195-209.
17. Swapnil S W, Shamshersingh C, Vikas P, Rahul J, Vipul C, Deepti V, Kailash K. When to Discharge a Patient After Endoscopy: A Narrative Review. Clin Endosc, 2022, 55(1):8-14.
18. Masamichi S, Akira H, Michio T, Yasuyuki I, Masashi K, Yuta Y, Naoki T. Safety and Effectiveness of Nurse-Administrated Propofol Sedation in Outpatients Undergoing Gastrointestinal Endoscopy. Clin Gastroenterol and Hepatol, 2019, 17(6):1098-1104.
19. Fadi Abu B, Amir M, Abu Ras Hakeem, Barouch O, Yael K. Propofol sedation in colonoscopy: from satisfied patients to improved quality indicators. Clin Exp Gastroenterol, 2019, 12:105-110.
20. Joo Hyung K, Dae Hyun K, Jin Hong K. Low-dose midazolam and propofol use for conscious sedation during diagnostic endoscopy. Kaohsiung J Med Sci, 2019, 35(3):160-167.
21. Thi Tran T, Sascha Beutler S, Richard Urman D. Moderate and deep sedation training and pharmacology for nonanesthesiologist: recomandations for effective practice. Curr Opin Anesthesiol, 2019, 32:457-463.
22. Fahima D, Braeden M, Christine K, Sergio Acuna A, Nancy Baxter N. Propofol versus midazolam with or without short-acting opioids for sedation in colonoscopy: a systematic review and meta-analysis of safety, satisfaction, and efficiency outcomes. Gastrointestinal Endoscopy, 2020, 91(5):1015-1026.
23. Justin G. M; Jennifer K. Chapter 37: Procedural Sedation and Analgesia in Adults. Tintinalli's Emergency Medicince: A Comprehensive Study Guide, 9th Edition, 2019, 1:36.
24. Minmin X, Jian T, Hongbin Z, Jing Z. No increased risk of perforation during colonoscopy in patients undergoing propofol versus traditional sedation: A meta-analysis. Indian J Gastroenterol, 2018, 37(2):86-91.
25. Y. Wu, Y. Zhang, X. Hu. A comparision of propofol vs. Dexmedetomidine for sedation, haemodynamic control and satisfaction, during esophagogastroduodenoscopy under conscious sedation. J Clin Pharm Ther, 2015, 40(4):419-425.
26. Kelsey Miller A, Gary A, James Miner R, John Burton H, Baruch Krauss K. Clinical practice guideline for emergency department procedural sedation with propofol: 2018 update. Ann Emerg Med, 2019, 73(5):470-480.
27. Fiona Burton M, David Lowe J, Jonathan M, Alasdair Corfield R, Malcolm SAB. A study protocol for a feasibility study: Propofol Target-Controlled Infusion in Emergency Department Sedation (ProTEDS)-a multi-center feasibility study protocol. Pilot Feasibility Stud, 2019, 5:27.
28. Schnider Thomas W, Minto Charles F, Struys Michel MRF, Absalom Anthony R. The safety of target-controlled infusions. Anesth Analg, 2016, 122(1):79-85.
29. Green Steven M, Krauss Baruch S. Target-controlled infusions could improve the safety and efficacy of emergency department propofol sedation. Anesth Analg, 2016, 122(1):283-284.
30. Sinan U, Bunyamin G, Esin Kabul G, Turgut D, Adnan H, Dogan Y. A comparision of propofol and midazolam/meperidine sedation in upper gastrointestinal endoscopy. Wideochir Inne Tech Maloinwazyjne, 2016, 11(3):178-185.
31. Robert Sneyd J, Anthony Absalom R, Clemens Barends R.M, Jordan Jones B. Hypotension during propofol sedation for colonoscopy: a retrospective exploratory analysis and meta-analysis. Br J Anaesth, 2022, 128(4):610-622.

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