

Factors Affecting Postoperative Nausea and Vomiting in Sedated Patients for Interventional Radiology Procedures: A Prospective Observational Study

Girişimsel Radyoloji İşlemleri için Sedasyon Uygulanan Hastalarda Postoperatif Bulantı ve Kusmayı Etkileyen Faktörler: Prospektif Gözlemsel Çalışma

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ABSTRACT

Objective: Interventional radiology (IR) offers minimally invasive alternatives with reduced risk and faster recovery compared to traditional surgery. However, postoperative nausea and vomiting (PONV) remain common complications. This study explores the incidence and predictors of PONV in patients undergoing sedation anesthesia for IR procedures.

Method: Ethical approval was obtained for this study at Hacettepe University Hospital from January to August 2023. Participants included patients aged 18 and older with American Society of Anesthesiologists scores of 1-3, undergoing sedation anesthesia. Exclusions involved those with pre-existing nausea, nausea-inducing medications, or conditions predisposing to nausea. Data collected included demographics, PONV history, comorbidities, smoking status, medications, anesthesia duration, and sedatives used. Nausea and vomiting were assessed using the Abramowitz emetic scoring scale. Predictors of PONV were analyzed using univariate and multivariate logistic regression.

Results: Of 213 patients (112 females, 101 males), 12.2% experienced nausea and 1.9% experienced vomiting. A history of PONV was a significant predictor of recurrence (OR=12.39, p<0.001). Although the use of multiple sedatives was associated with higher nausea rates, this was not statistically significant. Excluding volatile anesthetics and specific patient demographics likely contributed to lower PONV rates than those reported in the literature.

Conclusion: The study underscores the importance of considering patient history and limiting sedative use to manage PONV in IR anesthesiology effectively. The exclusion of volatile anesthetics and demographic factors significantly influenced the PONV incidence. Findings advocate for personalized sedation strategies and further research into specific sedative

Keywords: Interventional radiology anesthesia, sedation, PONV

ÖZ

Amaç: Girişimsel radyoloji (GR), geleneksel cerrahiye kıyasla daha düşük risk ve hızlı iyileşme süreci sunan minimal invaziv bir alternatiftir. Ancak postoperatif bulantı ve kusma (POBK) sık görülen komplikasyonlar arasında yer almaktadır. Bu çalışma, GR’lerde sedasyon anestezisi uygulanan hastalarda POBK insidansını ve öngördürücü faktörleri araştırmayı amaçlamaktadır.

Yöntem: Etik kurul onayı alınarak Ocak–Ağustos 2023 tarihleri arasında Hacettepe Üniversitesi Hastanesi’nde prospektif gözlemsel çalışma yürütülmüştür. Çalışmaya Amerikan Anestezistler Derneği skoru 1–3 olan, 18 yaş ve üzeri hastalar dahil edilmiştir. Önceden mevcut bulantısı olan, bulantıya neden olabilecek ilaç kullanan veya bulantıya yatkınlık oluşturan durumu bulunan hastalar çalışma dışında bırakılmıştır. Demografik veriler, POBK öyküsü, komorbiditeler, sigara kullanımı, ilaçlar, anestezi süresi ve kullanılan sedatifler kaydedilmiştir. Postoperatif bulantı ve kusma, Abramowitz emetik skorlama ölçeği ile değerlendirilmiş, öngördürücüler tek ve çok değişkenli lojistik regresyon analizi ile incelenmiştir.

Bulgular: Toplam 213 hasta (112 kadın, 101 erkek) çalışmaya dahil edilmiştir. Hastaların %12,2’sinde bulantı, %1,9’unda kusma görülmüştür. Postoperatif bulantı kusma öyküsü, tekrar gelişimi için anlamlı bir öngördürücü bulunmuştur (OR=12,39, p<0,001). Birden fazla sedatif kullanımı daha yüksek bulantı oranları ile ilişkili olmakla birlikte istatistiksel olarak anlamlı bulunmamıştır. Uçucu anesteziğin kullanılmaması ve belirli demografik faktörler, literatürde bildirilen oranlara kıyasla daha düşük POBK oranlarıyla ilişkili bulunmuştur.

Sonuç: Girişimsel radyoloji anestezisinde POBK yönetiminde hasta öyküsünün dikkate alınması ve sedatif kullanımının sınırlandırılması önem taşımaktadır. Volatil anesteziğin dışlanması ve demografik faktörler POBK insidansını belirgin şekilde etkilemiştir. Bulgular, kişiselleştirilmiş sedasyon stratejilerinin uygulanmasını ve farklı sedatif kombinasyonlarına yönelik ileri araştırmalar yapılmasını desteklemektedir. Sedasyon protokollerinin standartlaştırılması, GR uygulamalarında hasta sonuçlarını iyileştirebilir.

Anahtar sözcükler: Girişimsel radyoloji anestezisi, sedasyon, POBK

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INTRODUCTION

Interventional radiology (IR), a rapidly advancing field characterized by increasingly sophisticated procedures and equipment, has revolutionized medical treatment by offering minimally invasive alternatives to traditional surgery. This discipline has become integral in managing a wide range of conditions, providing numerous benefits to patients, including reduced risk, pain, and shorter recovery times compared to open surgical procedures. The trend towards minimally invasive techniques is particularly advantageous for patients with significant comorbidities such as heart disease, diabetes, or compromised lung function, where traditional surgical interventions pose higher risks due to potential anesthesia-related complications and increased physiological stress (1,2).

The selection of anesthesia for IR procedures is influenced by several factors, including the complexity of the procedure, patient-specific considerations, and the required level of patient comfort. Sedation is commonly employed in IR to help patients relax and alleviate discomfort during procedures. The prevalence of sedation is attributed to its numerous advantages, such as the preservation of spontaneous breathing, facilitation of patient cooperation (e.g., during breath-holding maneuvers), rapid recovery from anesthesia, and swift return to daily activities. Moreover, sedation is often preferred for patients with significant comorbidities for whom general anesthesia may pose excessive risks (2,3).

Postoperative nausea and vomiting (PONV) is a frequent and distressing complication that typically occurs within the first 24 to 48 hours following surgical procedures. With documented rates of 30% in all postoperative patients and up to 80% in high-risk patients, PONV is one of the most prevalent reasons for patient discontent following anesthesia (4). Postoperative nausea and vomiting encompasses a spectrum of symptoms, including nausea (the sensation of an urge to vomit), retching (involuntary, labored contractions of the abdominal muscles without expulsion of stomach contents), and vomiting (the forceful expulsion of stomach contents through the mouth). Postoperative nausea and vomiting can lead to various complications, such as dehydration, electrolyte imbalances, aspiration pneumonia, wound dehiscence, and increased postoperative pain. It is a significant cause of patient discomfort and can prolong hospital stays, thereby escalating healthcare costs. The incidence of PONV is influenced by multiple factors, including the type of surgery, anesthetic agents used, and individual patient risk factors such as a history of motion sickness or previous episodes of PONV (5,6).

Despite the rising frequency of non-operating room interventional procedures and the corresponding increase in procedural sedation, there is a relative paucity of studies addressing PONV in this context. The present study aims to fill this

gap by examining the factors that influence nausea and vomiting in patients undergoing IR procedures under sedation anesthesia. By identifying and understanding these factors, this study seeks to improve patient outcomes and enhance the overall safety and efficacy of sedation practices in IR.

MATERIAL and METHODS

This study was approved by the Hacettepe University Ethics Committee (Approval Number GO 22/976, Date: 29.11.2022). Informed consent was obtained from all participants.

Participants

Participants consisted of patients aged 18 years and older with an American Society of Anesthesiologists (ASA) score of 1-3 who underwent procedures under sedation anesthesia in the IR department of Hacettepe University Hospitals between January and August 2023. Patients experiencing nausea and vomiting at the time of the procedure, those taking medications that could cause or exacerbate nausea and vomiting (such as chronic opioids, cancer drugs, hormone therapy, oral contraceptives), those using medications for nausea and vomiting prophylaxis (antiemetic and antihistamine drugs), those with a health condition that could cause nausea and vomiting (such as pregnancy, malignancy, upper gastrointestinal disorders), and those with communication problems (such as advanced mental retardation, psychiatric illness) were excluded from the study.

Materials and Procedure

The demographic characteristics (age, gender), history of PONV, presence of comorbidities, smoking history, medications used, antibiotic used, anesthesia duration, types of sedatives (Fentanyl, ketamine, midazolam, propofol) were documented. Additionally, intraoperative, and post-anesthesia care unit oxygen saturation, pulse rate, blood pressure, and respiratory rate were continuously monitored and recorded. Nausea and vomiting data were collected in postoperative period using the Abramowitz emetic scoring scale (7). According to this scoring system, nausea and vomiting were assessed as two separate parameters, ranging from 0 (absent) to 4 (continuous). In our study, we categorized patients into two groups: those who experienced no nausea or vomiting (score of 0) and those who did (scores higher than 0).

Statistical Analyses

The data was examined by the Shapiro-Wilk test to determine whether or not it presents a normal distribution. The results were presented as mean $\pm$ standard deviation or frequency with percentage. Categorical variables were compared using Pearson chi-square and Fisher's exact tests between groups. Binary logistic regression analysis was performed to

examine the factors associated with nausea. Statistically, the significance level was accepted as $\alpha=0.05$. Statistical analyses were performed with IBM Statistical Package for the Social Sciences (SPSS) ver.28.0 (IBM Corp. Released 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp.).

RESULTS

During the data collection period, a total of 225 patients underwent procedures under sedation anesthesia in the IR unit. Of these patients, 12 were excluded from the study due to not meeting the inaccessible patient data. A total of 213 patients (112 females, 101 males) were included in the study (Figure 1). The mean age of the patients was 58.23 ± 15.54 years. Nausea occurred at a rate of 12.2% ($n=26$), while vomiting occurred at a rate of 1.9% ($n=4$). Propofol, ketamine, midazolam, and fentanyl were the preferred drugs for sedation. Interventional procedures included in the study were categorized into 8 main groups: Biopsies, drainage procedures, nonvascular diversion procedures, central venous catheters, percutaneous sclerotherapy/ablations, tumor/organ/lesion embolization, arterial interventions, and vascular venous interventions. Close to half of the procedures consisted of biopsies (27.2%, $n=58$), and drainage procedures (21.6%, $n=46$) (Table I).

In the evaluation of whether the given anesthetics are associated with nausea, univariate logistic regression analysis showed that age and preoperative history of PONV were significant variables, while the other variables were found to be insignificant and thus excluded from the model. According to the results of the multivariate logistic regression analysis, PONV history ($\beta = 2.545$, $p < 0.001$) was significant factors. A one-unit increase in PONV history was associated with 12.39 times increase in the likelihood of nausea (95% CI [3.722,

41.305]). The logistic regression model was statistically significant, χ^2 ($df=5$, $n=213$) = 24.450, $p < 0.001$. The model explained 20.7% (Nagelkerke R^2) of the variance and correctly classified 88.3% of cases (Table II).

Although it was observed that all sedation medications increased the incidence of nausea and vomiting, no statistically significant relationship was found between the type of drugs and the occurrence of nausea and vomiting (Table III). The Fisher-Freeman-Halton test was applied to examine the effects of anesthetic and opioid combinations on nausea. The most used agents were the combination of fentanyl and midazolam (36%, $n=77$). As the number of drugs in the combinations increased, there was a corresponding increase in nausea rates. In 17 patients where all agents (midazolam, fentanyl, ketamine, and propofol) were used together, the nausea rate was 35.3%, while no nausea was observed in single-drug use. Nausea rates were around 10% in dual combinations. However, there was no statistically significant relationship found between nausea rates and single or combination of anesthetics and opioids (Table IV).

DISCUSSION

The present study investigated the incidence of PONV in patients undergoing sedation anesthesia for IR procedures and identified associated factors. We found that a prior history of PONV is a significant predictor of recurrence during sedation anesthesia in IR. Additionally, while the use of multiple sedative agents was linked to increased nausea and vomiting, this finding was not statistically significant. These results underscore the importance of considering patient history and limiting the use of multiple sedatives to reduce PONV.

In our IR patient group, the incidence of PONV was lower compared to rates reported in the literature for sedation anesthesia. Contributing factors include the exclusion of volatile anesthetics from our protocol, patient demographics (e.g., average age over 50, majority being smokers, and a low proportion of female participants), and procedural aspects (e.g., an average anesthesia duration of less than 1 hour) (8,9). Excluding volatile anesthetics likely had the most significant impact, as they are known major risk factors for PONV (10).

Although all sedatives used increased the incidence of nausea and vomiting, no significant relationship was found between the type of sedatives and these adverse events. The literature documents the antiemetic effect of propofol and the emetic effect of fentanyl, though the combination of these agents did not significantly affect nausea in our study (11). However, the trend towards higher nausea rates with multiple agents suggests further research into specific sedative combinations and doses is needed.

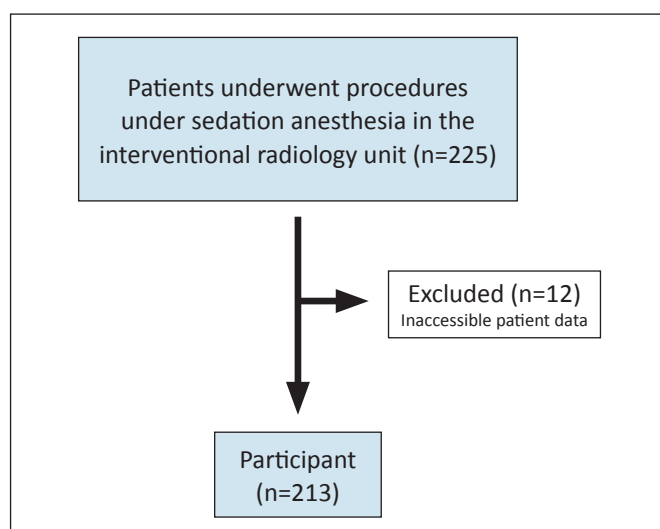


Figure 1. Flow diagram.

Table I. Demographic and Clinical Characteristics of the Patients

		n	%
Age (Years)			58.23 ± 15.54
Gender	Female	112	52.6
	Male	101	47.4
PONV History		15	7.0
Smoking		78	36.6
Cancer		95	44.6
Chronic Renal Disease		8	3.8
Diabetes Mellitus		46	21.6
Medication		65	30.5
Anesthesia Duration (min)			38.72 ± 30.68
Interventional Procedures	Biopsies	58	27.2
	Drainage procedures	46	21.6
	Non-vascular diversion procedures	30	14.1
	Central venous catheters	20	9.4
	Percutaneous sclerotherapy and ablations	17	8
	Tumour/organ/lesion embolization	17	8
	Arterial interventions	16	7.5
	Vascular venous interventions	9	4.2
Sedatives and Opioids	Fentanyl	171	80.3
	Ketamine	103	48.4
	Midazolam	207	97.2
	Propofol	45	21.1
Combinations	Fentanyl	1	0.5
	Ketamine	4	2
	Midazolam	7	3.5
	Ketamine+propofol	1	0.5
	Midazolam+fentanyl	77	36
	Midazolam+ketamine	28	13
	Midazolam+fentanyl+ketamine	51	24
	Midazolam+fentanyl+propofol	24	11
	Midazolam+ketamine+propofol	3	1.5
	Midazolam+ketamine+propofol+fentanyl	17	8
Contrast Medicine		96	45.5
Antiemetic (postoperative)		23	10.8
Nausea		26	12.2
Vomiting		4	1.9

PONV: Postoperative nausea and vomiting. Descriptive statistics are reported as mean ± standard deviation, n, and %.

Our study also highlighted that a history of PONV is a significant risk factor for nausea during sedation anesthesia. Patients with a history of PONV were 12.39 times more likely to experience nausea compared to those without such a history, consistent with prior research (12,13). Patients with a previous history of PONV are at a higher risk due to factors

such as individual susceptibility and genetic predispositions, including variations in the serotonin receptor and transporter genes (14). The consensus guidelines for the management of PONV emphasize the importance of assessing patient history as a critical step in risk stratification and management (15). This finding emphasizes the importance of assessing patient history and implementing preventative measures, such as multimodal antiemetic prophylaxis and tailored anesthesia plans, to improve patient outcomes in sedation anesthesia.

As the use of anesthesia in IR becomes more prevalent, a collaborative team approach is crucial for managing PONV. Anesthesiologists, interventional radiologists, and other specialists should work together to evaluate patient histories, select appropriate anesthetic agents, and consider potential drug interactions. Standardizing anesthesia protocols across studies could provide valuable data for optimizing sedation practices and improving patient care in IR. This collaborative approach will ensure that all team members contribute to minimizing PONV and enhancing patient care.

Table II. Binary Logistic Regression Results associated with Nausea

	p	OR	OR 95% Confidence interval	
			Lower	Upper
Age	0.222	0.983	0.956	1.010
PONV history	<0.001	12.399	3.722	41.305
Fentanyl	0.607	1.397	0.391	4.994
Ketamine	0.051	2.627	0.996	6.934
Propofol	0.072	2.168	0.783	6.006

PONV: Postoperative nausea and vomiting, **OR:** Odds ratio.

Table III. The Presence of Nausea and Vomiting according to the Use of Anesthetics and Opioids

		No use		Use drugs		p
		n	%	n	%	
Presence of nausea	Fentanyl	4	9.5	22	12.9	0.553
	Ketamine	9	8.2	17	16.5	0.064
	Midazolam	0	0.0	26	12.6	1.000
	Propofol	18	10.7	8	17.8	0.199
Presence of vomiting	Fentanyl	1	2.4	3	1.8	1.000
	Ketamine	0	0.0	4	3.9	0.053
	Midazolam	0	0.0	4	1.9	1.000
	Propofol	3	1.8	1	2.2	1.000

Table IV. Examining the Presence of Nausea according to the Anesthetics and Opioid Combinations

		NAUSEA				p
		yes		no		
		n	%	n	%	
Ketamine	n=4	0	0.0	4	100.0	0.118
Midazolam	n=7	0	0.0	7	100.0	
Midazolam+fentanyl	n=77	8	10.4	69	89.6	
Midazolam+ketamine	n=28	3	10.7	25	89.3	
Midazolam+fentanyl+ketamine	n=51	7	13.7	44	86.3	
Midazolam+fentanyl+propofol	n=24	1	4.2	23	95.8	
Midazolam+ketamine+propofol	n=3	1	33.3	2	66.7	
All	n=17	6	35.3	11	64.7	

Due to the insufficient sample size, ketamine + propofol (n=1), and fentanyl (n=1) were not included in the analysis.

This study adds to the growing body of literature on PONV in sedation anesthesia and provides insights for optimizing patient care in IR settings, despite some limitations. Future research should involve multicenter studies with larger and more diverse samples to enhance generalizability. Detailed investigations into the effects of specific anesthetic combinations and doses, as well as standardizing methods, could improve our understanding and patient care in sedation anesthesia.

CONCLUSION

This study provides valuable insights into PONV incidence in patients undergoing sedation anesthesia for IR procedures. We found that a prior history of PONV significantly predicts recurrence, while the use of multiple sedative agents increases nausea and vomiting. Minimizing the use of multiple sedatives and considering PONV history are essential strategies for reducing PONV. This research highlights the need for tailored sedation approaches in IR settings and suggests further investigation into specific sedative combinations and doses. Standardizing anesthesia protocols could enhance our understanding and improve patient care in IR.

AUTHOR CONTRIBUTIONS

Conception or design of the work: MT, AHK

Data collection: MT, CB, FGE, EÜ

Data analysis and interpretation: MT

Drafting the article: MT, CB

Critical revision of the article: BP, AHK

Other (study supervision, fundings, materials, etc): AHK

The author (MT, CB, FGE, EU, BP, AHK) reviewed the results and approved the final version of the manuscript.

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