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FULL PAPER

The effect of different surgery positions on postoperative nausea and vomiting induced due to chemical anesthesia

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Risk factors related to postoperative nausea and vomiting (PONV) affect the patient's health; however, most of these multi-factorial risks are unknown. The current study aimed to investigate unknown factors associated with PONV as well as the effect of different positions during surgery on postoperative nausea and vomiting. In this study, 180 patients are scheduled for elective orthopedic surgery during 2018 is investigated. Patients were divided into two groups, with 90 subjects. In the recovery unit, the incidence of nausea and vomiting in each group was recorded based on the position during surgery. The highest and lowest prevalence of nausea was in the supine position (43.66%) and sitting position (15.49%) groups, respectively. The duration of recovery stay ($P<0.05$), the severity of nausea ($P<0.05$), and the need for anti-antiemetic drugs ($P>0.05$) had a significant effect on the incidence of nausea in all positions. Also, the highest prevalence of vomiting was in the supine position group (21.11%). While the lowest prevalence of nausea was in the lateral position group (4.43%). The severity of nausea ($P<0.05$) and need for Antiemetic drugs ($P<0.05$) had a significant effect on the incidence of vomiting in all positions. Based on the findings, the supine position is a risk factor for nausea and vomiting. Also, for female obese patients, the sitting position is a risk factor, and it's better to be avoided.

KEYWORDS

Vomiting; nausea; position; surgery; chemical anesthesia.

Introduction

Postoperative Nausea and Vomiting (PONV) arises in 20-30% of patients; up to 80% of high-risk patients experience this problem so that it is the second common problem in patients after pain [1,2]. PONV is one of the major complications of anesthesia which delays hospital discharge. Without preventive interventions, nausea and vomiting arise in about one-third of patients under general anesthesia. It's reported that, based on the perspective of patients, PONV is more important than postoperative pain, so that patients tend to pay any amount of money to prevent this problem [3,4].

Also, PONV causes stress for the patient, surgeon, and anesthesiologist. It also may cause a feeling of distress and turmoil, disgust, increased anxiety, and inefficiency of the patient. However, in the long-term, it may result in hypotension, reduced heart rate, fatigue in the abdomen, irritability, sleep disturbance, and fear of damage to the upper part of the gastrointestinal tract, bleeding, increased intraocular pressure, increased skull pressure, and wounds and skin cracks [5,6]. These complications are mainly

attributed to the patient and anesthesia. However, these complications may cause consequences such as aspiration of gastric contents and wound dehiscence, and delayed recovery and hospital discharge. According to what was mentioned before, preventing PONV is more effective than its treatment; however, some patients require postoperative treatment, even after receiving preventive interventions [7,8].

The continued need to better understand PONV prevention and treatment is emphasized by more than 3,000 published clinical trials. Mainly because its risk factors are not well identified yet, as well as discovering better and more effective preventive and therapeutic interventions. Several unknown risk factors are introduced and discussed so far, including gender, type of surgery (due to its higher prevalence in women), anesthetic drugs, and opioids. Therefore, it is better to be considered as a multi-factorial complication that requires multi-factorial treatment [9,10].

On the other hand, many surgeries are associated with a high prevalence of PONV, such as thermoplastic or abdominal surgeries. Is the type of surgery a risk factor for PONV? It is believed that overdose of anesthesia drugs in long surgeries or consumption of opioids contribute to this problem; therefore, it may be more logical to consider independent predictors as risk factors rather than the type of surgery. Considering the risk factors which are often considering as multi-factorials that affect the patients' health due to the nature of the surgery; the present study aimed to investigate risk factors that affect PONV as well as the effects of various positions during surgery in order to take a step toward improving patients' health after surgery.

Method

Study design

This descriptive-comparative study was conducted on patients scheduled for elective orthopedic surgery in an orthopedic hospital in Iran during 2018. The minimum sample size was calculated based on preliminary data including the prevalence of nausea (from the study by Lambert), a confidence interval of 95%, the study power of 80%, and a two-sequence test with 20% change in the main variable (i.e., nausea and vomiting). The minimum sample size was calculated as 90 for each group. Based on the position during the surgery, participants were divided into four groups of (1) supine, (2) lateral, (3) prone, and (4) sitting position. Subjects were selected using the convenience sampling technique among qualified individuals.

$$N = [(Z1-\alpha/2 + Z1 - \beta)\ 2 \times (P1 \times (1-P1) + P2 \times (1-P2)]/\ (P1-P2)2$$

Inclusion and exclusion criteria

Inclusion criteria were being a candidate for elective orthopedic surgery and willingness to participate. Non-inclusion criteria were: (1) drug addiction, (2) history of Motion disease, and (3) history of gastrointestinal disorders. The exclusion criterion was patients who needed another position during surgery (more than one position during surgery).

Implementation

Before performing surgery, routine monitoring was performed, including measurement of arterial oxygen saturation, diastolic and systolic blood pressure, and ECG. Then, anesthesia was performed by injecting 500 cc of normal saline serum. Induction and continuation of anesthesia were the same for all patients, as intravenous total anesthesia (inhalation drugs and N2O were avoided). To eliminate the effect of inhaled drugs, anesthesia was continued using total IV anesthesia (TIVA). Depending

on the type of surgery, a particular position was used. It should be noted that the anesthesiologist was not involved in choosing the position during the surgery. After surgery and in the Post-Anesthesia Care Unit, nausea and vomiting of patients were investigated. Data on the following variables were collected: age, sex, weight, height, place of surgery, duration of surgery, position during surgery, the incidence of nausea in the recovery unit, the incidence of vomiting in the recovery unit, and the use of anti-nausea medication. Concerning the occurrence of nausea and vomiting, four categories were defined: (1) no nausea, (2) mild nausea, (3) moderate nausea, and (4) very severe nausea.

Ethical considerations

The informed consent was comprised of three aspects of information, complete understanding, and voluntariness. In any research on humans, all participants should be properly informed about the objectives, methods, beneficial outcomes, possible risks and harms of the study. After collecting and categorizing, the data were coded into the computerized statistical analysis system. Besides, according to the ethical requirement, all patients' information was kept completely confidential. All criteria of the ethics committee, as well as medical ethics principles, were observed to protect patients' information. Informed written consent was obtained from all patients, and permission was obtained for access to their medical records, as well. Ethic No is IR.TBZMED.REC.1397.065.

Statistical analysis

Data were entered into SPSS version 24 by a statistical consultant who was a member of the research group. Qualitative data and variables are described using frequency and percentage, while the quantitative data were analyzed using mean and standard deviation. The Kolmogorov-Smirnov test was applied to test for a normal distribution. Data with a normal distribution were analyzed using the t-student, while for the other data; the Mann-Whitney test was used. One-way ANOVA and chi-square test were used to compare the quantitative and qualitative demographic and basic variables, respectively. To compare different states, logistic regression and Mann-Whitney test were used, after adjusting basic values and controlling cofounder variables. Statistical significance was considered when p-value <0.05.

Results

According to the findings, of 90 participants, 53 (58.90%) were men, and the rest were women. The mean (SD) age and body mass index (BMI) of participants were 36.71±12.72 years and 26.33±33.4, respectively. Of 90 participants who had lateral position, 73 (81.10%) were men, and the rest were female. The mean (SD) age and BMI were 40.91±13.74 years and 26.11±1.22, respectively. Of 90 participants in the prone position, 31 (34.42%) were men, and the rest were women. The mean age and BMI were 45.12±10.42 years and 29.12±3.24, respectively. Of the 90 participants who had sitting positions, 63 (70%) were men, and the rest were women. The mean age and BMI were 42.13±11.74 years and 27.51±2.72 years, respectively.

In the supine group, the prevalence of nausea was 31, 15 in the lateral group, 14 in the prone group, and 13 in the semi-sitting group. Also, the prevalence of vomiting in the supine group was 19, 4 in the lateral group, 9 in the prone group, and 8 in the semi-sitting group (Table 1).

TABLE 1 Prevalence of nausea (different severities) and vomiting in different groups of the study

Variable		Position			
		Supine	Lateral	Prone	Beach chair
Nausea	No	59 (65/61%)	75 (83/32%)	76 (84/41%)	77 (85/63%)
	Low	12 (13/31%)	3 (3/32%)	4 (4/45%)	11 (12/23%)
	medium	3 (3/31%)	3 (3/31%)	3 (3/31%)	-
	Very intense	16 (17/74%)	9 (10%)	7 (7/72%)	2 (2/21%)
Vomit		19 (21/11%)	4 (4/43%)	9 (10%)	8 (8/91%)

Based on the findings, for patients with supine position, blood loss during surgery (p=0.049), the severity of nausea (p=0.003), length of stay in recovery unit (p=0.008), and need for Antiemetic drugs (p=0.002) were associated with vomiting and its severity. For patients with the lateral position, the incidence of nausea and its severity were associated with the severity of nausea (p=0.009) and the need for Antiemetic drugs (p=0.001). For patients with the prone position, the nausea incidence and its severity were associated with bleeding during surgery (p=0.024), length of stay in recovery unit (p=0.035), age (p=0.015), and need for Antiemetic drugs (p=0.001). Last but not least, for patients with a semi-siting position, the incidence of nausea and its severity during surgery were associated with BMI (p=0.001), gender (p=0.026), need for Antiemetic drugs (p=0.001), and length of stay in the recovery unit (p=0.032) (Table 2).

TABLE 2 The results of the statistical analysis of factors affecting nausea and the impact of different positions during surgery

Variable	Influential variable	Lateral P Value	Supine P Value	Prone P Value	Beach chair P Value
Prevalence of nausea	BMI	0/881	0/825	0/751	0/001
	Sex	0/402	0/312	0/617	0/012
	Age	0/752	0/280	0/177	0/490
	surgery Duration	0/161	0/501	0/342	0/275
	Bleeding during surgery	-	0/049	0/024	-
	Recovery Duration	0/082	0/112	0/035	0/002
Number of nausea	Bleeding during surgery	-	0/429	0/474	-
	Nausea Severe	0/009	0/003	0/137	0/083
	Recovery Duration	0/831	0/008	0/652	0/721
	Consumption of antiemetic	0/272	0/002	0/331	0/342
Severe nausea	surgery Duration	-	0/861	0/015	0/119
	Consumption of antiemetic	0/179	0/015	0/045	0/241
	Bleeding during surgery	0/001	0/202	0/006	0/501
	Recovery Duration	0/192	0/112	0/192	0/311

Concerning the incidence of vomiting during surgery, for those with supine position, the need for Antiemetic drugs (p=0.001) and severity of nausea (p=0.002) were associated with the incidence of postoperative vomiting. For those with a lateral position, severity of nausea (p=0.010), and need for Antiemetic drugs (p=0.001) were associated with the incidence of vomiting during surgery. For those with a prone position, blood loss during surgery (p=0.012), the severity of nausea (p=0.002),

and the need for Antiemetic drugs (p=0.001) were associated with the incidence of vomiting during surgery. For those with a semi-sitting position, there was a significant association between BMI (p=0.019), need for Antiemetic drugs (p=0.001), and duration of surgery (p=0.009) (Table 3).

TABLE 3 The results of the statistical analysis of factors affecting vomiting and the impact of different positions during surgery

Variable	Influential variable	Supine	Lateral	Prone	Beach chair
		P Value	P Value	P Value	P Value
Prevalence of Vomit	BMI	0/241	0/412	0/296	0/019
	Sex	0/512	0/459	0/459	0/549
	Age	0/312	0/196	0/369	0/811
	surgery Duration	0/721	0/778	0/336	0/019
	Bleeding during surgery	0/152	-	0/012	-
	Recovery Duration	0/512	0/715	0/153	0/136
	Consumption of antiemetic	0/001	0/001	0/001	0/589
	Nausea	0/002	0/010	0/002	0/515

Discussion

Considering multiply risk factors which often affect the patient's health, this study aimed to investigate the unknown risk factors of PONV as well as the effect of various positions on the incidence of nausea and vomiting. When the surgeon can choose a surgery position, it can be used as a method to prevent nausea and vomiting. Considering the emphasis on identifying unknown factors and risk factors associated with the incidence of PONV and the lack of a comprehensive and accurate study on the effects of patients' position during surgery on PONV, the present study aimed to investigate the impact of different surgery positions on postoperative nausea and vomiting. Based on the findings, some risk factors such as gender and BMI contribute to the prevalence of PONV [5, 11].

Initial evaluation of the frequency of different surgery positions of patients with a history of various levels of PONV revealed the importance of patients' position. So that 43% of them had supine position, 21% lateral, 19% prone, and 15% sitting. According to the findings, it seems that the supine position has the highest risk of nausea and vomiting. However, this conclusion is not decisive and may be due to the characteristics of the participants. A systematic review by APFEL *et al*. [12] has investigated the effect of independent risk factors on PONV, and while confirming the previous risk factors, they did not provide a comprehensive conclusion regarding the impact of surgery position. On the other hand, Sawatzky *et al*. [13], in a prospective study on factors affecting PONV on 671 patients, reported the effect of previous risk factors. They also reported that the type of surgery was more effective on the prevalence of vomiting than nausea.

The results concerning the association between patients' physical characteristics (e.g., BMI) and incidence of nausea and vomiting are controversial. In the present study, there was no significant association between BMI and postoperative nausea for patients with supine, lateral, and prone positions [7]. Nevertheless, based on the findings, for patients with a sitting position, there was a significant association between BMI and vomiting as well as the severity of vomiting. In other words, it can be argued that, for patients with a sitting position, BMI can play an important role and should be

considered as a risk factor. Hence, in the sitting position, overweight and obese people are more susceptible to PONV [14].

Safiya *et al*. [15] investigated the combined effect of identified risk factors on PONV. Their results cannot be generalized to the general public. However, their recommendations, such as proper oxygenation and accelerating patients transfer to the recovery unit are effective factors that can generally reduce PONV which is consistent with the findings of the present study. They also reported a significant association between the incidence of nausea and duration of recovery unit stay, so that the higher the recovery stay, the lower would be the risk of nausea and its severity.

Concerning the effect of taking Antiemetic drugs and the severity of nausea and its repetition, as well as the prevalence of postoperative vomiting in all positions, a significant association was found so that according to the literature and expectations, consumption of Antiemetic drugs, as an intervening variable has a significant effect on the severity and incidence of postoperative vomiting [16].

Also, based on statistical analysis, for those with a prone position, a significant association was found between the incidence of complications during surgery and vomiting and nausea. Besides, a significant association was found between supine position and nausea, and we found no significant association between the need for blood transfusion during surgery and postoperative vomiting. In general, due to the lack of reporting complications of this operation in lateral and sitting positions, the incidence of complications cannot be investigated as a general risk factor [17].

Evidence regarding the association between gender and postoperative nausea and vomiting is controversial. In the present study, there was no significant association between gender and severity of postoperative nausea for supine, lateral, and prone positions. Also, there was no significant association between gender and incidence, as well as the severity of nausea in the sitting position. In other words, it can be argued that female patients with a sitting position are at increased risk of nausea. A significant association was found between the duration of stay in the recovery unit and nausea, but there was no significant association between the duration of surgery and nausea. Hence, gender can be considered as an effective risk factor in the severity of postoperative nausea in the sitting position [18].

This study demonstrated that some risk factors, such as length of stay in the recovery unit or using Antiemetic drugs for all positions, were effective in reducing PONV. Some positions, such as sitting, compared to factors such as BMI and gender, were more sensitive, which should be investigated in future studies.

The current study has limitations, including low sample size, selecting patients from only one center, only considering orthopedic surgeries, and not exactly considering the type of surgery.

Conclusion

Based on the findings, length of recovery stay and using Antiemetic drugs were associated with reduced prevalence of nausea and vomiting. It seems that the supine position is a risk factor for nausea and vomiting. Moreover, for female obese patients, the sitting position is a risk factor, and it's better to be avoided. The authors recommend addressing the limitations of the present research in future studies. The authors also recommend further studies to increase the generalizability of the findings.

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