Risk factors for postoperative nausea and vomiting following maxillofacial surgery

Maksillofasiyal cerrahiden sonra gelişen postoperatif bulantı kusma için risk faktörleri

Abstract

Aim: The aim of this study was to determine the risk factors for postoperative nausea and vomiting (PONV) in maxillofacial surgery and contribute to its prevention.

Methods: 93 patients (42 female, 51 male) who underwent maxillofacial surgery under general anesthesia were included in the study. No postoperative rescue antiemetic medications were given to patients. One investigator recorded patient-related anesthesia-related and surgery-related variables. The nausea and pain were evaluated postoperatively by means of Visual Analogue Scale. Total number of vomiting in the first 24 hours after surgery and number of days of hospital stay were recorded.

Results: The risk factors most associated with postoperative nausea and vomiting were found to be female sex, increased bleeding, submental intubation, prolonged operation time, and postoperative pain. No significant relationship was found between smoking, age, BMI, receiving GA for the first time and PONV in context of maxillofacial surgery.

Conclusion: Given its prevalence and significant consequences, prevention of postoperative nausea and vomiting is an important consideration. It may be useful to take preoperative and postoperative precautions in patients with one or more risk factors.

Keywords: Anesthesia; oral surgery; postoperative complications; postoperative nausea and vomiting.

Öz

Amaç: Bu çalışmanın amacı maksillofasiyal cerrahide postoperatif bulantı ve kusma için risk faktörlerini belirlemek ve önlenmesine katkıda bulunmaktır.

Yöntemler: Çalışmaya genel anestezi altında maksillofasiyal cerrahi operasyon geçirmiş 93 hasta (42 kadın, 51 erkek) dahil edildi. Hiçbir hastaya postoperatif kurtarıcı antiemetik ilaç verilmedi. Veri toplamak amacıyla hastayla ilgili, anestezi ile ilgili ve cerrahi operasyon ile ilgili değişkenler kaydedildi. Bulantı ve kusmadan en az birinin varlığı postoperatif bulantı ve kusma vakası olarak tanımlandı. Postoperatif bulantı ve ağrı, Görsel Analog Skala ile değerlendirildi. Cerrahi operasyon sonrası ilk 24 saatteki toplam kusma sayısı ve hastanede kalış gün sayısı kaydedildi.

Bulgular: Postoperatif bulantı ve kusma ile en fazla ilişkili risk faktörleri kadın cinsiyet, artmış intraoperatif kanama, uzamış operasyon süresi, submental entübasyon ve postoperatif ağrı olarak bulundu.

Sonuç: Yaygınlığı ve önemli sonuçları göz önüne alındığında, postoperatif bulantı ve kusmanın önlenmesi önemli bir hususdur. Bu bakımdan risk faktörlerinden bir veya daha fazlasına sahip hastalarda ameliyat öncesi ve sonrası önlem alınması faydalı olabilir.

Anahtar Sözcükler: Anestezi; oral cerrahi; postoperatif komplikasyonlar; postoperatif mide bulantısı ve kusma.

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Received/*Geliş* : 14.08.2023
Accepted/*Kabul*: 03.09.2023

DOI: 10.21673/anadoluklin.1342640

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INTRODUCTION

Postoperative nausea and vomiting (PONV) is one of the most common and disturbing complications after surgery performed under general anesthesia (GA) (1,2). The multifactorial etiology and complex pathogenesis mechanism of PONV make it difficult to prevent its occurrence. Although the etiology of PONV cannot be clearly revealed, the factors that increase the risk are examined under 3 main headings: Patient related, anesthesia related, and surgery related (3).

PONV's undesirable consequences, such as opening surgical wounds, increased bleeding and hematoma, delayed return to normal oral diet, malnutrition and weight loss, prolonged hospital stay, delayed discharge and increased cost, can cause difficulties for both patients and surgeons (2-4). It can also lead to more serious complications such as the aspiration of gastric contents, dehydration, electrolyte disturbances, esophageal rupture, and increased intracranial and intraocular pressure (2,3). In some cases, PONV may even be fatal, increasing postoperative morbidity (2,4). It was reported that PONV occurs in at least 1 out of every 5 patients after maxillofacial surgery and 75% of these occur within the first 2 hours postoperatively. Also PONV may extend up to 5 days after discharge, which is considered the most sensitive time period in the surgery and recovery process (4-6).

PONV following maxillofacial surgery has not been widely examined in the existing literature despite its high occurrence rate and compelling results. Therefore, the present study aimed to determine the risk factors for PONV and contribute to its prevention in maxillofacial surgery. The null hypothesis was that no relationship existed between the predisposing and postoperative risk factors, and the occurrence of PONV.

MATERIAL AND METHODS

This study was planned as an observational clinical study, adhering to STROBE guidelines, to evaluate the prevalence and possible risk factors of PONV in patients who underwent elective maxillofacial surgery under GA at the Department of Oral and Maxillofacial Surgery, Hamidiye Faculty of Dentistry, University of Health Sciences.

The principles of Helsinki Declaration were followed while conduction of the present research. This study was approved by Hamidiye Clinical Research Ethics Committee at the University of Health Sciences (date: 08.09.2020, decision no: 20-98). Signed informed consent forms were obtained from all patients. The inclusion criteria were: Patients between the age of 18-65 years, patients who were classified as American Society of Anesthesiologists (ASA) physical status I and II, patients who agreed to participate in the study. Exclusion criteria were: Being under the age of 18 years, refusing to participate in the study, not being able to communicate, receiving cancer chemotherapy or immunosuppressive treatment, having a degenerative musculoskeletal system disease, taking antiemetics up to 4 hours before the operation, having a history of prolonged nausea and vomiting for various reasons previously.

The study included 93 patients (42 female (45.1%), 51 male (54.8%)). The patients' ages ranged from 19 to 65 years, and the mean age was 32 years. All patients underwent the same anesthesia induction and maintenance procedures and were given intraoperative opioids. All patients were prescribed postoperative non-steroidal anti-inflammatory drugs (NSAID) to control pain and inflammation. No interventions were performed for patients who developed PONV and no postoperative rescue antiemetic medications were given to any patients. The involved maxillofacial surgeries included tumor excision, temporomandibular joint (TMJ) surgery and trauma surgery, performed with extraoral approach; while orthognathic surgery (single or double jaw), cyst enucleation, alveolar augmentation, mini-plate explantation, genioplasty, zygomatic implants were performed with intraoral approach..

Data were collected using a form consisting of two main sections:

a. Predisposing risk factors

This section consisted of 3 parts: Patient-related, anesthesia-related, and surgery-related factors. Patient-related factors were age, sex, body mass index (BMI), ASA classification, smoking status, existence of concomitant systemic disease or gastrointestinal problems, history of motion sickness, and history of migraine. Anesthesia-related factors were the type of intubation used and whether the patient was being op-

erated on under GA for the first time. Surgery-related factors were the procedure type (intraoral or extraoral approach), operation duration, and amount of bleeding.

Body mass index (BMI) of the patients at the time of surgery were recorded. Patients were classified as underweight (BMI < 18.5 kg/m²), normal (BMI = 18.5–24.9 kg/m²), and overweight (BMI > 25 kg/m²) according to the World Health Organization (WHO) classification (7). The duration of the surgical procedure was calculated from the induction of GA to the time of extubation. The results were divided into 3 groups as; less than 1 hour, 1-2 hours or more than 2 hours. The amount of intraoperative bleeding (ml) was calculated based on the formula: *Intraoperative bleeding = Total amount of discharge – irrigation.* The results were divided into 3 groups as: 0-100 ml, 100-300 ml, 300 ml and more.

b. Postoperative period

Postoperative period was evaluated as postoperative pain, the total hospital stay of the patient in days, the degree of nausea and the number of vomiting. Pain was measured at the 1st, 2nd, 4th and 24th hours postoperatively using a visual analog scale (VAS; 0: no pain, 10: worst imaginable pain).

For assessment of nausea and vomiting, patients were asked if they had nausea 1, 2, 4 and 24 hours postoperatively. The degree of nausea was rated using VAS, and the total number of vomiting in the first 24 hours were recorded. The presence of either nausea or vomiting was defined as a case of PONV.

Primary study outcome was to detect the possible risk factors. Secondary outcome was to evaluate the correlation between the significant risk factors and the occurrence of PONV.

Statistical analyses

G*Power software *(version 3.1.9.2, Heinrich-Heine-University Düsseldorf, Germany)* was used for the sample size calculation. The calculation indicated that a minimum of 81 patients was required for a power of 0.90 and an alpha of 0.05 to obtain an effect size of 0.15.

The study data were analyzed using the MedCalc Statistical Software version 12.7.7 (MedCalc Software Ltd, Ostend, Belgium; http://www.medcalc.org; 2013). The results were analyzed statistically using Spearman's rho correlation analysis, Mann Whitney U, Wilcoxon and Friedman test and Multiple Logistic Regression analysis. Results were considered to be significant at 5% critical level ($p < 0.05$).

RESULTS

Patient-related factors

Sex: PONV occurred in 29 patients (31.1%; 11 female). A statistically significant association between sex and PONV was noted in females (p=0.018). The numbers and percentages of PONV development in the groups were given in Table 1.

Age: PONV was highest in the 3rd decade (39.2%), but there was no statistically significant difference between PONV development and any of the age decades (p=0.222).

ASA classification and comorbidities: ASA I (n=75) accounted for 80.6% and ASA II (n=18) accounted for 19.3% of the patient population. Diabetes mellitus (n=4) and hypertension (n=4) were the most common (22.2%) comorbidities. There was no statistically significant difference between ASA I and ASA II in terms of PONV occurrence (p=0.367). None of the patients reported a history of motion sickness, 1 patient reported a history of migraine, and 2 patients reported gastrointestinal problems. Their effects on PONV could not be evaluated statistically due to inadequacy.

Body mass index (BMI): In the present group, 8.6% (n=8) were underweight, 67.7% (n=63) were normal weight, and 23.6% (n=22) were overweight. There was no statistically significant difference between the BMI groups in terms of PONV development (p=0.116).

Smoking: Majority of the subjects were smokers (n=58, 62.3%). PONV developed in 34.4% of smokers and 25.7% of non-smokers. Although there was a higher prevalence of PONV among smokers, this was not statistically significant (p=0.34).

Anesthesia-related factors

First time of GA: 60.2% of the patients (n=56) received GA for the first time. Of the 29 patients who developed PONV, 16 received GA for the first time (55.1%). No statistically significant difference was found between

Table 1. Percentages and numbers of variables in terms of PONV development.

Parameters	Percentage and number of PONV developers	p values
Sex		
Female	58.6% (n=17)	
Male	41.3% (n=12)	***p=0.018***
Type of intubation		
Nazal	65.5% (n=19)	
Oral	3.44% (n=1)	
Submental	31% (n=9)	***p=0.007***
Amount of bleeding		
0-100 ml	27.5% (n=8)	
100-300 ml	27.5% (n=8)	***p=0.031***
>300 ml	44.8% (n=13)	
Operation duration		
<1 hour	17.2% (n=5)	
1-2 hours	41.3% (n=12)	***p=0.02***
>2 hours	41.3% (n=12)	

*PONV: Postoperative nausea and vomiting. n: Number.

those who underwent GA for the first time and the others in terms of PONV (p=0.089).

Type of intubation: 74 (79.6%) of the patients were intubated nasally, 14 (15.1%) submentally and 5 (5.4%) orally. The development of PONV was statistically significant in the submental intubation group (p=0.007).

Surgery-related factors

Type of surgical approach: Extraoral approach (EO) rate was 18.3% (n=17) while intraoral (IO) was 81.7% (n=76). The type of surgical approach was not statistically significantly associated with PONV (p=0.799).

Duration of operation: The mean duration of the operations was 132 minutes. A statistically significant correlation was found between the duration of the operation and PONV. PONV was highest in patients with an operation time of 2 hours or more (p=0.02).

Amount of bleeding: The mean amount of intraoperative bleeding (ml) was 162.47 ml, ranging between 50 to 700 ml. A statistically significant positive correlation was found between the amount of bleeding and PONV. PONV was lowest in patients with bleeding less than 100 ml (p=0.031).

Postoperative factors

Pain level: A statistically significant positive correlation between postoperative pain and PONV was found (p=0.032).

Hospital stay: The mean hospital stay was 1.65 days, ranging from 1 to 6 days. The length of hospital stay was statistically positively correlated with PONV (p=0.024).

The degree of nausea and the number of vomiting: According to measurements made in the first 24 hours, 21 of 29 patients (72.4%) who developed PONV had only nausea and 8 (27.6%) had both nausea and vomiting. The number of vomiting in the first 24 hours after surgery ranged from 1 to 4. Of the 8 patients who vomited, 5 (62.5%) were female. A statistically significant negative correlation was found between the time elapsed after the operation and PONV in all patients. PONV was highest in both genders at 1 hour postoperatively and decreased over time (p<0,05).

DISCUSSION AND CONCLUSION

PONV was reported as the most common postoperative complication following oral and maxillofacial surgery (8). Despite developments in surgical and pharmacological techniques, the incidence of PONV has increased from 9-43% to 75-80% in the last 40 years, highlighting the need for research on this subject (5,6).

There are many studies on PONV developing after abdominal, gynecological and other surgical procedures. However, few studies have evaluated the incidence of and risk factors for PONV in maxillofacial

surgery. Moreover, the impact of the vast majority of the factors that can increase the risk of PONV remains unclear. In the present study, the risk factors to be investigated were selected by compiling previous studies, including all the factors that were encountered in the literature, regardless of whether there was a consensus about their contribution to PONV.

Gan listed the limitations of research on PONV as follows: the inability to comprehensively examine genetic and other molecular biological patient characteristics, the method of data collection, the applicability of findings in adults to children and the elderly, and the difficulty of controlling for subtle clinical factors, such as the experience of the surgical team or anesthetic team (9). Moreover, it was reported that PONV studies in the literature are largely retrospective, with data obtained by scanning of patient charts, yet direct and private inquiry is believed to capture a larger percentage of the actual incidence of PONV (9). Postoperative measurements were recorded in real time in the present study to overcome this limitation.

Albuquerque et al. reported the rate of PONV development after maxillofacial surgery as 24.2%. Philips et al. reported this rate as 67% for nausea and 27% for vomiting (4,10). The overall incidence of PONV was 31.1% in the present study. Female gender was identified as an important risk factor for PONV in almost all prior studies (11,12) and the present study is consistent with literature in respect to gender.

The effect of age on PONV remains unclear. Philips et al. reported that age was not a significant risk factor for PONV (10). In contrast, Sinclair et al. reported that for every 10-year increase in age, the probability of PONV decreases by 13% (13). In the present study, although the PONV rate was highest in the 2nd decade, there was no statistically significant difference between the decades. However, different results can be obtained in a study including the 1st decade of age (10,13).

ASA physical condition was defined as a 'conflicting risk factor' in the Fourth Consensus Guidelines for the Management of PONV (14). However, in this study, the relationship between ASA status and PONV was not statistically significant.

The relationship between BMI and PONV has been interpreted in different ways in different studies. Silva et al. reported a trend towards less PONV as BMI increased. However, Gan et al. reported that BMI had little clinical relevance to PONV. Similarly, in this study, the effect of BMI on PONV was not statistically significant (5,15).

Although there is a general opinion in the literature that smoking reduces the risk of PONV, some recent studies have reported that there is no statistically significant relationship between smoking status and PONV (5,16). In this study, no statistically significant relationship was found between smoking status and PONV despite a higher incidence of PONV in smokers. This may reflect the fact that the majority (62.3%) of the patients in the present study were smokers.

Apfel's scale, which is frequently used to determine the risk of PONV, includes history of motion sickness and postoperative opioid use as predisposing factors. In the present study, all patients were given opioids intraoperatively only and a wait-and-see policy was applied for PONV (17-19). In addition, none of the patients had a history of motion sickness, so the contribution of postoperative opioid use and history of motion sickness to PONV could not be evaluated.

GA was reported to be risky for PONV compared to local / locoregional anesthesia (20). Repetitive GA has been reported to be associated with behavioral and emotional disturbances in young people (21). From this point of view, we aimed to examine whether being under GA for the first time has an effect on PONV. However, there was no statistically significant difference between those who received GA for the first time and those who had previously received GA.

Another anesthesia-related factor is the type of intubation. Few prior studies have addressed the relationship between intubation and PONV. Albuquerque et al. found no statistically significant relationship between nasal and oral intubation in terms of PONV development, although they observed that the incidence of vomiting was higher in patients who were intubated nasally (4).

In this study nasotracheal, orotracheal and submental intubation was chosen were chosen on a case-by-case basis. Submental intubation is advantageous in that it allows intraoperative evaluation of dental occlusion throughout the operation (22). Therefore, we preferred submental intubation in trauma and orthognathic surgery.

The complexity of these surgeries, as well as the associated prolonged operation time and increased bleeding may explain the relationship between submental intubation and PONV that we found in this study.

The effect of mean operative time on PONV is well documented. Alexander et al. reported that each 30-minute increase in operation time increases the risk of PONV by 60% due to prolonged exposure to anesthetic agents (23). In this study, the average duration of surgery was statistically significantly longer for those who experienced PONV. PONV was highest in patients with an operation time of 2 hours or more.

Blood is an emetogenic substance and can easily reach the stomach in IO surgical procedures (4). For this reason, PONV rates can be expected to be higher in surgeries performed intraorally. In the study, precautions such as placing a throat pack at the beginning and aspiration of the gastric contents at the end of the operation, were applied to all patients, to minimize blood swallowing and to ensure that the swallowed blood was expelled.

Although all TMJ surgeries (n=16) in the study were performed with EO approach, the TMJ group, isolated from the risk of blood reaching the mouth and stomach, ranked second for the incidence of PONV (37.5%), reflecting the multifactorial etiology of PONV.

Pain is also one of the factors thought to play a role in the etiology of PONV. Tramèr et al. reported that surgical patients preferred to suffer pain rather than postoperative nausea and vomiting. However, multiple studies have shown a relationship between pain and nausea (24). Similarly, PONV in the absence of pain was not reported in this study.

Andersen reported that people in pain are often nauseated and that proper relief of pain, even by opiates, will often relieve nausea. In a study in which they investigated the relationship between pain and nausea, it was reported that the pain was not completely relieved without relieving the nausea, and that while nausea often accompanies pain in the early postoperative period, it can be relieved concomitant with the pain (25).

PONV is one of the most unpleasant and frequent complications after surgery. It impairs wound healing, reduces patient satisfaction and increases hospital healthcare costs (1). Therefore, it remains important to develop strategies to minimize PONV. The main goal of the study was to identify the most common patient-related, anesthesia-related and surgery-related risk factors for PONV and to arouse interest in further prospective studies toward the development of efficient preventive protocols.

In the present research, female sex, increased bleeding, submental intubation, prolonged operation time and postoperative pain were found to be most associated with PONV. No significant relationship was found between smoking, age, BMI, receiving GA for the first time and PONV in context of maxillofacial surgery. Also, patients with PONV had longer hospital stay, which was extended up to 6 days. The relatively small sample size and the fact that the study was conducted in a single medical center can be cited as limitations of this study. Further studies with a larger sample group from more than one center are needed to improve our understanding of PONV after maxillofacial surgery.

Acknowledgement

We would like to acknowledge the Department of Oral and Maxillofacial Surgery at the Hamidiye Faculty of Dentistry, University of Health Sciences.

Conflict-of-interest and financial disclosure

The authors declare that they have no conflict of interest to disclose. The authors also declare that they did not receive any financial support for the study.

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