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ORIGINAL ARTICLE

Relationship between the incidence and risk factors of postoperative nausea and vomiting in patients with intravenous patient-controlled analgesia

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Summary *Objective:* This study aims to evaluate retrospectively the electronic medical records of surgical patients who received intravenous patient-controlled analgesia, to identify potential relationships between the incidence and risk factors of postoperative nausea and vomiting (PONV).
Methods: Records of 6773 adult patients who received fentanyl-based intravenous patient-controlled analgesia after surgery at Chung-Ang University Hospital between January 1, 2010 and December 31, 2015 were reviewed. Multiple logistic regressions were used to identify risk factors for PONV.
Results: Of 6773 patients, 1216 (18.0%) were recorded to have PONV. In multiple logistic regression analysis, female gender, nonsmoking status, history of motion sickness or PONV, use of desflurane and nitrous oxide, and preintubation use of opioid analgesia were independent risk factors for PONV.
Conclusions: Despite the use of antiemetic prophylaxis, 18.0% of patients with intravenous patient-controlled analgesia had PONV. Use of desflurane and nitrous oxide, in addition to risk factors included in the Apfel score (female gender, nonsmoking status, history of PONV or motion sickness, and use of postoperative opioids) were identified as independent risk factors. As the incidence of PONV was 2.8%, 6.0%, 11.7%, 15.2%, 21.1%, 50.0%, and 100% for patients who

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had 0, 1, 2, 3, 4, 5, and all these risk factors, respectively, risk-adapted, multimodal, or combination therapy should be applied for patients receiving general anesthesia.

1. Introduction

Postoperative nausea and vomiting (PONV) is one of the most common complications after general anesthesia and surgery. It can be very unpleasant for patients, who may even consider it the most troublesome experience in addition to postoperative pain.[1,2] Various factors, such as patient characteristics, the method of anesthesia, and the type of surgery can affect the incidence of PONV.

Opioids have an important role in routine postoperative analgesic therapy.[3] A previous study showed that up to 75% of patients might suffer from postoperative pain, with up to 30% of them experiencing moderate or severe postoperative pain.[4] Therefore, proper management of postoperative pain is required to improve the quality of outcomes for patients and to prevent postoperative complications.

Patient-controlled analgesia (PCA) allows patients to self-administer medications to relieve pain and is an effective method of postoperative pain control.[5] However, postoperative opioid usage was reported to be a risk factor for PONV.[6] Therefore, patients receiving intravenous patient-controlled analgesia (IV-PCA) have at least one risk factor for PONV, suggesting that effective evaluation of PONV and prophylactic treatment must be considered to reduce or prevent the incidence of PONV.

In this retrospective study, we evaluated the incidence and identified the risk factors of PONV in patients who received IV-PCA treatment and a single dose of prophylactic antiemetic.

2. Methods

The present study was approved by the Institutional Review Board of Chung-Ang University Hospital (Seoul, Korea) in August 2016 (C2016173[1916]), and because the study involved the evaluation of pre-existing de-identified electronic medical records of patients, the requirement for informed consent was waived. The manuscript was prepared according to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.[7]

This was a retrospective cohort study involving the evaluation of prospectively collected medical records of 6773 patients who received fentanyl-based IV-PCA after surgery at Chung-Ang University Hospital between January 1, 2010 and December 31, 2015. The exclusion criteria for this study were patient age below 19 years and patient refusal of PCA.

Data were collected by a nurse who had been working in our hospital for more than 10 years and as a PCA specialist for more than 5 years. She only undertakes tasks related to IV-PCA and makes rounds of patients who have had IV-PCA at least once daily to collect information regarding PONV, pain scores, and other postoperative complications such as headache, dizziness, or requirement of rescue antiemetic. Data were collected only by this nurse, who had received training regarding standardized scoring variables [pain visual analog scale and nausea numerical rating scale (NRS)] before the commencement of this study. Data collected by the nurse during the first 2 years (2008–2009) were not included in the analysis.

The data included 21 demographic characteristics, as well as anesthetic, surgical, or PCA-related factors closely related with the incidence of PONV. Specifically, we collected data on age, gender, body mass index, smoking status, history of PONV or motion sickness, type of anesthetic agent used (propofol, desflurane, or sevoflurane), and use of nitrous oxide (N_2O) or remifentanil. Additionally, data were also collected on the use of anticholinergics (glycopyrrolate) as premedication, preintubation opioid or intraoperative opioid, nefopam, ketorolac, ramosetron, palonosetron or granisetron in IV-PCA, and reversal agents; the dosage of fentanyl in IV-PCA; laparoscopic surgery; and the duration of surgery. In addition, the severity of pain and nausea, frequency of vomiting (expulsion of stomach contents or involuntary retching not productive of stomach contents), incidence of headache and dizziness, discontinuation of PCA, and administration of rescue antiemetics on Postoperative Days 0 and 1 were analyzed.

The severity of nausea was rated using a five-point NRS as follows. If the patient felt absolutely no sensation of nausea, the score was 0; mild sensation, 1; moderate sensation, 2; and severe sensation, 3; and if the patient felt as if he/she was about to vomit, the score was 4. Use of a "rescue antiemetic" indicated that an additional antiemetic treatment was given during the postoperative period. According to our hospital protocol, antiemetics were administered by patient request or when the degree of nausea was 3 or greater on the NRS. Metoclopramide was given as a first-line drug, and if the nauseating sensation persisted, ramosetron or palonosetron was administered via the IV route. PONV cases were defined by the presence of nausea (NRS $\geq$1), vomiting, or requirement of rescue antiemetic medication during Postoperative Days 0 and 1.

According to our hospital protocol, general anesthesia was maintained at an average of 1.5 ± 1 minimal alveolar concentration of desflurane or sevoflurane. Either 0.05–0.10 μg/kg/min of remifentanil was administered throughout surgery or a 2 μg/kg bolus of fentanyl was administered 2 minutes before the intubation with 50% N_2O and the volatile anesthetic given thereafter. If the patient felt pain during anesthesia, the anesthesiologist administered a 1 μg/kg bolus of fentanyl for pain control.

We used the standardized IV-PCA protocol of the Department of Anesthesiology and Pain Medicine in our institution, which was a continuous infusion of 1 mL/h, as well as a bolus of 1 mL with a 15-minute lockout interval. The 100-mL IV-PCA solution contained fentanyl, ketorolac

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