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Original contribution

The impact of isoflurane, desflurane, or sevoflurane on the frequency and severity of postoperative nausea and vomiting after lumbar disc surgery

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Abstract

Study Objective: To test the hypothesis that anesthesia with the low-soluble inhalation anesthetics, sevoflurane, and desflurane, may result in a lower frequency and severity of postoperative nausea and vomiting (PONV) than anesthesia with isoflurane.

Design: Prospective, observational study.

Setting: Postoperative care unit and neurosurgical ward at a university hospital.

Patients: 625 ASA physical status I, II, and III patients undergoing elective lumbar disc surgery with general anesthesia were included in this study.

Interventions: Patients were enrolled sequentially to receive either 0.7%-1.2% isoflurane (year 2002), 3.5%-5.5% desflurane (year 2003), or 1.2%-1.9% sevoflurane (year 2004) for maintenance of anesthesia without nitrous oxide. Study personnel, general anesthesia management, and surgical technique remained unchanged over the three-year study period.

Measurements: Occurrence of PONV within 24 hours of the end of surgery was recorded. Secondary outcome measures were occurrence of multiple PONV episodes, maximum severity, time to the first PONV event, need for rescue medication, difference between the occurrence of PONV (indicator variable) and the expected risk of PONV (based on the Apfel score).

Main Results: Type of inhalation anesthetic had no influence on PONV frequency (9.3%, 11.2%, and 10.8% after isoflurane, desflurane, and sevoflurane, respectively; $P = 0.8$) or its severity (numerical

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rating scale, 4.5 ± 2.0, 4.4 ± 2.4, and 4.2 ± 2.1; $P = 0.9$). Patients who received isoflurane experienced fewer early events but had a late peak of PONV frequency ($P = 0.031$). For every 10 minutes by which the total duration of the anesthesia exceeded the net time between incision and suture, the risk of PONV increased by a factor of 1.36 (95% confidence interval, 1.15-1.61; $P < 0.001$).

Conclusions: There is no difference between the three inhalation anesthetics currently used with regard to frequency or severity of postoperative nausea, vomiting, or both.

1. Introduction

The results of meta-analyses show clearly that patients in whom anesthesia has been maintained with propofol have a significantly lower incidence of postoperative nausea and vomiting (PONV) than those who have been given inhalation agents [1,2]. Our information on differences between isoflurane, desflurane, and sevoflurane is based largely on studies of the recovery behavior of patients after outpatient surgery, in which PONV was only a secondary end point [3-7]. A meta-analysis by Gupta et al [8] showed sevoflurane to have a lower frequency of postdischarge nausea than isoflurane; there were insufficient data for a comparison between desflurane and isoflurane. Another meta-analysis of trials comparing recovery after anesthesia with sevoflurane and desflurane, by Macario et al [9], showed no significant differences in PONV between these two inhalation anesthetics.

The more rapid recovery after the less-soluble inhalation anesthetics, sevoflurane and desflurane [8,10], as compared with the older inhalation anesthetic, isoflurane, may result in a lower incidence and/or severity of PONV. Furthermore, different pharmacological traits such as solubility in blood, lean tissue and fat, metabolic transformation and elimination (reduced hepatic metabolism of concomitant medications, amount of fluoride ions), or different effects on stress hormone changes [11], may be responsible for different side effects and complications such as PONV. Whatever the nature of the inhalation anesthetic used, the incidence and severity of PONV are influenced by risk factors such as female gender, nonsmoker status, and history of PONV [12,13]; by the type of surgery [14,15]; and by the opioid and antiemetic drugs used in the perioperative course of anesthesia [16,17].

The objective of the present study was to compare the frequency and severity of PONV between the three inhalation anesthetics, isoflurane, desflurane, and sevoflurane, under largely standardized conditions (one type of surgery, one opioid, the same PONV prophylaxis) with a sufficient number of cases and adjustment of the analysis for risk factors on the part of the patient that were known to exist before the operation.

2. Patients and methods

The study protocol was approved by the Ethics committee of the Medical Faculty of the University of Leipzig. From January 2002 to December 2004, all ASA physical status I, II, and III patients who were scheduled for elective lumbar disc surgery and decompression for lumbar stenosis were prospectively enrolled in this nonrandomized cohort study. The operating procedures (minimally invasive microsurgical approach) were therefore nearly the same for all patients. General anesthesia management and study personnel did not change within this three-year period either. Exclusion criteria were current treatment with antiemetic drugs or psychoactive substances, including tricyclic antidepressants; planned fiberoptic intubation; disposition to malignant hyperthermia; Parkinson's disease or other extrapyramidal-motoric impairment; history of epileptic seizures; hepatic or renal insufficiency; participation in other trials, or pregnancy or breast-feeding.

Patients were given midazolam 0.1 mg/kg as oral premedication. After arrival at the operating room, an intravenous (IV) catheter was placed, and standard monitoring was established. All patients in the study received the opioid fentanyl at induction and also during maintenance of anesthesia. Anesthesia was induced with 4 to 5 mg/kg thiopental sodium or 0.2 to 0.3 mg/kg etomidate, and 0.6 mg/kg rocuronium bromide was given to facilitate tracheal intubation. Volume-controlled, pressure-limited ventilation with 30% to 40% oxygen in air was adjusted to maintain end-tidal carbon dioxide pressure ($ETCO_2$) at 35 to 40 mmHg. Patients were enrolled sequentially to receive either 0.7%-1.2% isoflurane (year 2002), or 3.5%-5.5% desflurane (year 2003), or 1.2%-1.9% sevoflurane (year 2004) for maintenance of anesthesia.

After induction of anesthesia, patients were placed in the relevant surgical position (genupectoral or Wilson frame-supported prone position) and moved back before cessation of anesthesia. Thirty minutes before the end of surgery, all patients received 10 mg metoclopramide and 8 mg dexamethasone, IV. The rescue medication used, if necessary, was initially dimenhydrinate or, in second line, dolasetron. No gastric tubes were used. A postoperative drinking test was not permitted until 4 hours after the end of the operation. Patients' demographic data, risk factors for PONV, and postoperative opioid use (piritramide three mg boli, IV, in the postoperative care unit [PACU] and 7.5-15 mg subcutaneous boli, in the neurosurgical ward) were documented in a study protocol. Doses of dexamethasone administered additionally during the operation (excessive manipulation of spinal nerve roots) were recorded precisely. Recovery of neuromuscular block was controlled by train-of-four stimulation. Patients