



Review Article

Incidence of postoperative shivering comparing remifentanyl with other opioids: a meta-analysis[☆]



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Received 14 July 2015; accepted 3 August 2015

Keywords:

Remifentanyl;
Postoperative shivering

Abstract

Study Objective: To determine whether the administration of remifentanyl increases the incidence of postoperative shivering in comparison with the administration of alfentanil, fentanyl, or sufentanil.

Design: Meta-analysis.

Setting: Operating room and postanesthesia care unit.

Measurements: We performed a computerized search of articles on PubMed, MEDLINE, and Scopus. Meta-analysis was performed using Review Manager and the DerSimonian and Laird random-effects model. The pooled effect estimates for binary variables were calculated as relative risk (RR) values with 95% confidence intervals (CIs).

Main Results: Eighteen randomized controlled trials met our inclusion criteria. Remifentanyl was associated with a significantly increased incidence of postoperative shivering compared with other opioids (RR = 2.17; CI, 1.76–2.68; $P < .00001$; $I^2 = 0.00\%$). A subgroup analysis of remifentanyl compared with alfentanil, fentanyl, or sufentanil showed that only sufentanil had a similar rate of postoperative shivering incidence (RR = 2.13; CI, 0.67–6.74; $P = .20$; $I^2 = 0.00\%$). Remifentanyl administration was associated with a significant increase in the incidence of postoperative shivering compared with the administration of other opioids when both propofol (RR = 2.44; CI, 1.52–3.92; $P = .0002$; $I^2 = 0.00\%$) and inhalation anesthesia drugs (RR = 2.45; CI, 1.46–4.11; $P = .0007$; $I^2 = 0.00\%$) were used for anesthesia maintenance. In addition, the administration of remifentanyl at both low (RR = 2.06; CI, 1.63–2.60; $P < .00001$; $I^2 = 0.00\%$) and high dosages (RR = 2.77; CI, 1.67–

[☆] We have no conflicts of interest.

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4.57; $P < .0001$; $I^2 = 0.00\%$) was associated with a significant increase in the incidence of postoperative shivering compared with the administration of other opioids.

Conclusions: Our meta-analysis showed that remifentanyl was associated with an increased incidence of postoperative shivering compared with alfentanil or fentanyl, but no significant difference was seen when compared with sufentanil.

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1. Introduction

The unique feature of remifentanyl among the opioids is its extremely rapid onset of action. In general, remifentanyl is considered to increase the incidence of postoperative shivering compared with other opioids [1-3]. The incidence of postoperative shivering has been reported to range from 20% to 70% in previous studies of general anesthesia using remifentanyl [4,5].

Postoperative shivering is an unpleasant and common complication in the postoperative period [6]. The etiology of postoperative shivering is unclear, and various mechanisms have been proposed. Shivering may develop as a thermoregulatory response to hypothermia or as a form of muscle hyperactivity, with clonic or tonic patterns that have a range of frequencies [6]. In the postoperative period, however, muscle activity may increase even under the condition of normothermia [7], suggesting that mechanisms other than heat loss and subsequent decrease in core temperature may contribute to the development of shivering.

In a shivering patient, oxygen consumption may increase by 200% to 500% [8,9]. In addition, hypothermia may trigger vasoconstriction and thus increase vascular resistance, which may lead to critical complications in the postoperative period such as myocardial infarction.

There have been several anecdotal reports of a high incidence of postoperative shivering associated with remifentanyl administration compared with the administration of other opioids [1-3]. However, other studies have shown that the use of remifentanyl in anesthesia does not increase the incidence of postoperative shivering [10-12]. In a previous meta-analysis by Komatsu et al. [13], remifentanyl was compared with other opioids in terms of the incidence of postoperative shivering. Their meta-analysis showed that remifentanyl was associated with an increased incidence of postoperative shivering compared with fentanyl and alfentanil. However, the incidence of postoperative shivering related to sufentanil administration could not be determined because of the limited number of articles. The meta-analysis by Komatsu et al included results contained in conference abstracts [14,15], and we were unable to acquire the results of 1 postoperative shivering trial [16]. In addition, papers that have been published since the meta-analysis by Komatsu et al showed no significant difference in the incidence of shivering when remifentanyl was compared with fentanyl or sufentanil [17-19].

Several clinical studies have suggested that the rate of postoperative shivering is influenced by the anesthesia maintenance agent that was used and the effects of low versus high remifentanyl dosages. But these topics have remained controversial, and there has been no meta-analysis of the incidence of shivering based on agents used for the maintenance of anesthesia or dosage of remifentanyl. In the current study, we performed a meta-analysis of randomized controlled trials to examine whether the administration of remifentanyl was associated with an increased incidence of postoperative shivering compared with the administration of alfentanil, fentanyl, or sufentanil. Our meta-analysis included new studies and excluded abstracts that were examined in the meta-analysis by Komatsu et al. Moreover, we also performed subgroup analysis to check whether drugs for the maintenance of anesthesia (propofol or inhalation drugs) and the dose of remifentanyl could be significant confounding factors in the analysis of the incidence of postoperative shivering.

2. Materials and methods

This quantitative systematic review was performed according to the criteria outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [20].

2.1. Inclusion and exclusion criteria

Inclusion and exclusion criteria were established a priori. This review included all randomized controlled trials investigating the incidence of postoperative shivering associated with remifentanyl compared with alfentanil, fentanyl, or sufentanil. We excluded observational studies and those published as an abstract.

2.1.1. Search strategy

A comprehensive literature search was performed using PubMed, MEDLINE, and Scopus. PubMed and MEDLINE searches were performed using the same search terms as follows: “shivering”[All Fields] AND “remifentanyl”[All Fields] AND “alfentanil”[All Fields] AND “sufentanil”[All Fields] AND “fentanyl”[All Fields] AND “randomized controlled trial”[Publication Type]. A Scopus search was performed using the following keywords: ALL “shivering” AND ALL “remifentanyl” AND ALL “alfentanil” AND ALL “sufentanil” AND ALL

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