



## Research Article

## Factors Affecting Unused Remaining Volume of Intravenous Patient-controlled Analgesia in Patients Following Laparoscopic Gynecologic Surgery



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## ARTICLE INFO

## Article history:

Received 3 July 2013

Received in revised form

20 May 2014

Accepted 26 June 2014

## Keywords:

analgesia

patient-controlled

drug and narcotic control

linear models

medical waste

postoperative nausea and vomiting

## SUMMARY

**Purpose:** This study was undertaken to evaluate the factors affecting the unused remaining volume of intravenous patient-controlled analgesia (IV PCA) in patients who had undergone laparoscopic gynecologic surgery.

**Methods:** We retrospectively collected patient records from pre-existing PCA log sheets from 98 patients. Surgical factors and IV PCA-related data including remaining volume, administration duration, early discontinuation (yes or no), and adverse reactions were recorded. Chi-square test, one-way analysis of variance, and multiple linear regression were applied for data analysis.

**Results:** The average age of the 98 patients was  $40.0 \pm 8.24$  years. The incidence of postoperative nausea and vomiting (PONV) and early discontinuation were not statistically significant among the different surgical groups ( $p = .540$  and  $p = .338$ , respectively). Twenty-eight patients wanted discontinuation of IV PCA and the remaining volume was  $33.6 \pm 7.8$  mL (range 20–55 mL). The significant determinants of remaining volume were whether IV PCA was discontinued due to PONV and duration of surgery ( $p < .001$ ). The surgical duration was inversely correlated with the remaining volume.

**Conclusion:** Early discontinuation of IV PCA due to PONV is a major contributing factor to wastage of medicine. Prevention and treatment of PONV is needed to encourage patients to maintain PCA use for pain control.

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## Introduction

Patient-controlled analgesia (PCA) allows patients to administer their own supplemental analgesics to relieve postoperative pain. Sechzer (1990) developed and introduced PCA in the 1970s. Then, effectiveness and management of PCA have been extensively discussed in the literature (Bollish, Collins, Kirking, & Bartlett, 1985; Hudcova, McNicol, Quah, Lau, & Carr, 2006). Since its introduction, PCA has become the mainstay of postoperative pain management strategy.

One frequently mentioned benefit of PCA is that it saves nursing time spent on analgesia-related activities, thus creating extra time

for other duties (Koh & Thomas, 1994). On the other hand, nurses take the main responsibility for monitoring the adverse effects of PCA. Chan, Chung, McQuestion, and Gomez (1995) reported the significant amount of time saved was offset by the total extra time spent on hourly patient monitoring and flow sheet recording of drug consumption and patient response. Opioids are the most effective drugs for moderate-to-severe postoperative pain relief and the main analgesics for PCA. The distribution of opioids is tightly regulated to prevent illegal diversion and abuse (Korea Ministry of Government Legislation, 2011). Anesthesiologists are primarily accountable for the prescription and administration of PCA to surgical patients, as well as for the proper disposal of any unused opioids. However, widespread prescription of potent opioids for PCA along with the increasing use of PCA beyond the operating theater has increased the volume of opioids that require disposal at wards and has extended the responsibility for the safe disposal of unused drugs to nurses.

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Although many studies have investigated the relationship between patient characteristics or surgical characteristics and analgesic consumption, we could not find a report addressing the wastage issue with PCA. Patient weight and site of surgery have been known to influence total PCA requirements (Chang, Tsou, Chan, Sung, & Chang, 2006). In addition, it has been reported that intravenous PCA (IV PCA) morphine intake was higher in younger patients and increased morphine use was also associated with surgical procedure and duration (Gagliese, Gauthier, Macpherson, Jovellanos, & Chan, 2008).

Unused medication is a waste of resource and increases the chance of its illegal diversion, in case of opioids (Herring, Shah, & Gupta, 2008). In this regard, it is necessary to identify influential factors on analgesic consumption to minimize wastage of analgesics, especially opioids.

Our hypotheses were as follows: First, the extent of surgical injury would be the main factor that determines the remaining volume in laparoscopic gynecologic surgery because evidence suggests that the site or type of surgery is well correlated with analgesic consumption in PCA use (Chang et al., 2006; Yen et al., 2010). Second, premature discontinuation would also affect the remaining volume because PCA is occasionally aborted and switched to intermittent analgesic administration due to adverse reactions such as postoperative nausea vomiting (PONV), dizziness, and urinary retention (Momeni, Crucitti, & De Kock, 2006).

The objective of this study is to identify factors affecting the unused remaining volume of IV PCA in patients following laparoscopic gynecologic surgery, and ultimately to contribute to efficient utilization of human and material resources.

## Methods

### Study design

This is a retrospective study designed to find out major contributing factors that determine the unused remaining volume of IV PCA.

### Setting and samples

The present study included 98 patients, 18–65 years old, who received IV PCA prepared with morphine and ketorolac following laparoscopic gynecologic surgery from September 2011 to February 2012. We collected data from a total inspection to illustrate a clear picture of PCA remaining volume and other predictors after laparoscopic gynecologic surgery. Therefore, we did not estimate minimum sample size. Pace (2008) recommended that the sample size be limited to the prevention of selecting falsely positive predictors. A regression model is likely to be reliable when the number of sample is less than “limiting sample size”, which is candidate predictors multiplied by 10 or 20. The sample size of 98 was satisfactory for identifying factors affecting the unused remaining volume of IV PCA in patients following laparoscopic gynecologic surgery (Harrell, 2001).

Laparoscopic gynecologic surgery was selected for several reasons. First, the patient population that needed gynecologic surgery was homogeneous with respect to health condition, gender and age, which could play as confounding variables in statistical analysis. Second, the remaining volumes in this group were quite varied compared to other surgical patients.

### Ethical considerations

This study was approved by the institutional review board of our hospital with waiver of informed consent because of the

retrospective nature of the study. We also complied with the institutional review board regulation, which stated that the information should be recorded by the investigator in such a manner that subjects cannot be identified in the research data directly or statistically, and no one could trace back from research data to identify a participant.

### Measurements

Prior to data collection, the principal researcher selected the potential predictors of PCA remaining volume including operation-related factors, patient demographics and PCA-related attributes.

Surgical factors including types and duration were analyzed. Since the extent of surgical injury is closely associated with analgesic consumption, the operations were categorized into four groups according to surgical procedure (Chang et al., 2006; Yen et al., 2010). IV PCA related data were remaining volume, administration duration, early discontinuation (yes or no), and adverse reactions. We defined early discontinuation when patient with higher numeric rating scale (>4) wanted replacement of IV PCA with intermittent administration of an analgesic due to adverse reaction. The IV PCA was discontinued on the basis of patient's request according to PCA protocol of our institution.

### Analgesia regimen

A total of 60 mL analgesic solution with 120 mg of ketorolac plus 60 mg of morphine with normal saline (ketorolac 1.2 mg/mL, morphine 1 mg/mL) was prepared with PCA device (AP 0605; E-Wha Fresenius Kabi Inc., Gumpo, South Korea). The baseline dose was 0.5 mL per hour with 0.5 mL bolus on demand. The lockout interval was set at 15 minute.

### Data collection

A total of 134 patient records were obtained from pre-existing PCA log sheets. After discarding incomplete PCA log file with missing remaining volume record, we collected 98 patients records.

### Data analysis

SPSS (version 20.0; IBM SPSS Statistics, Chicago, IL, USA) was used for statistical analysis and a *p* value less than .05 was considered statistically significant.

General characteristics of the patients in the four groups were expressed as mean and standard deviation for continuous variables, and absolute number and percentage for discrete variables. Age, weight, surgical duration, remaining volume, and duration of IV PCA administration in the four groups were analyzed with one-way analysis of variance. The incidence of PONV and early discontinuation among different surgical groups were analyzed with chi-square test.

Linear model using stepwise variable selection method was applied to find out influential variables, which could determine the unused remaining volume of IV PCA. Inclusion criteria and exclusion criteria were set at a significance level of .05 and .10, respectively. The variables used for model selection were age, weight, surgical duration, type of surgery, and early discontinuation (yes or no).

## Results

### Patient characteristics, surgical factors and IV PCA-related variables with different surgical groups

The average age of the 98 patients was  $40.0 \pm 8.24$  years (range 21–58 years). The length of surgery, patients' age and duration of IV

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