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Comparative analysis of patient-controlled analgesia versus traditional intramuscular injection in Chinese women undergoing elective gynaecological surgery

Key Messages

1. Women on patient-controlled analgesia used significantly larger amounts of morphine than those given intramuscular analgesia.
2. Although patient-controlled analgesia is a more effective means of managing pain post-abdominal hysterectomy, it costs HK\$81.10 more per patient.
3. Although they experienced more nausea, patients receiving patient-controlled analgesia were significantly more satisfied than those receiving intramuscular pain management.
4. If intramuscular analgesia is used for pain management, closer adherence to prescription and administration protocols is needed to improve pain control.

Introduction

Although intramuscular (IM) opioid analgesia is the most prevalent form of postoperative pain management, it leaves 50% or more patients with inadequate pain relief.¹ Patient-controlled analgesia (PCA) provides better pain control while minimising side-effects during the postoperative period.² In addition, PCA provides patients with a sense of control over their pain management. The evidence demonstrating the effectiveness of PCA is limited by small sample sizes, heterogeneous samples, estimates of pain during activity, and cost effectiveness.³

Aims and objectives

This study aimed to compare the efficacy and cost of intravenous PCA with intermittent IM morphine injection as postoperative pain management for Chinese women undergoing elective gynaecological surgery. Efficacy was estimated using comparisons of pain control, side-effect levels, and reported satisfaction. Cost-effectiveness was measured in terms of drugs, equipment, and personnel costs.

Methods

This study was conducted from December 1998 to May 2000. A prospective, randomised control design was adopted in order to compare the effectiveness of two postoperative pain management methods for Chinese women undergoing abdominal gynaecological surgery. All eligible subjects meeting the inclusion criteria were randomly assigned to either the experimental or control group by means of a computer-generated random-number table. Subjects in the experimental group received PCA after surgery. The control group subjects received traditional IM injections. Double blinding was not used in this study, as there were obvious differences in each method of pain management. However, the research assistant and the ward staff were blind to the research hypotheses to reduce the influence of any preconceived expectations.⁴

Instruments

Demographic data

Demographic data collected from all subjects prior to surgery, included age, date of birth, place of birth, level of education, reasons for having the surgery, previous surgery, marital status, number of children, occupation, diagnosis, and specific operation.

State anxiety

The level of anxiety experienced by women prior to the surgery was assessed using the Chinese version of the state scale of the State-Trait Anxiety Inventory⁵ (original English version developed by Spielberger et al⁶). The State-Trait

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Anxiety Inventory has been used extensively in research and clinical practice for measuring the transient situation-related level of anxiety. This tool consists of 20 statements that evaluate how respondents feel "right now, at this moment." The subjects rated each item on a 4-point Likert scale (1=not at all, 2=somewhat, 3=moderately so, and 4=very much so). The 20-item questionnaire had equal numbers of anxiety-present and anxiety-absent items. The anxiety-absent item scores were reversed prior to data analysis. The total scores ranged from a minimum of 20 to a maximum of 80.

Multidimensional Health Locus of Control Form C scale

The Multidimensional Health Locus of Control Form C scale (MHLC) is an 18-item scale assessing the way people with existing health or medical conditions view health-related issues.⁷ It comprises four subscales: internality (MHLCI) [6 items], chance (MHLCC) [6 items], doctors (MHLCD) [3 items], and other (powerful) people (MHLCO) [3 items]. The subjects rated each item on a 6-point scale ranging from strongly disagree (1) to strongly agree (6). The possible scores for the MHLCI and MHLCC subscales are 6 to 36 and for the MHLCD and MHLCO subscales is 3 to 18.⁸

Pain visual analogue scale

The visual analogue scale used was a 100 mm horizontal line with Chinese verbal anchors at either end (0='no pain at all'; 100='the worst pain imaginable'). The subject was asked to mark a point indicating the amount of the sensation experienced at the time. The intensity of each woman's pain was measured according to the number of millimetres from the left end of the scale to the subject's mark.⁹

Side-effect episodes

Sets of scale were developed to measure whether women experienced side-effects. Women were asked to recall whether or not they had experienced any nausea, vomiting, dizziness, or itchiness in the past 8 hours. The patients responded yes or no for each of the side-effects. This recording and observation was conducted by the research nurse 3 times within the 24-hour study period: morning, afternoon, and evening.

Patient satisfaction questionnaire

A Chinese version of the patient satisfaction questionnaire (PSQ) specific to pain management was modified for this study based on a previously available instrument.¹⁰ It consisted of seven items relating to satisfaction with the management of pain, knowledge of using a particular type of pain management, overall rating of the level of pain experienced, acceptability and preference for that type of pain management in the future. The subject rates each item on a 5-point scale with 1=strongly disagree and 5=strongly agree. The possible scores for the PSQ range from 7 to 35.

Cost-effectiveness data

The total costs for both types of pain management were

determined from the amount of equipment and drugs used as well as the nursing time needed. Data about the nursing time spent on pain-related activities was collected using nurses' self-reports. Data from patients' records were used to determine the amount of analgesia, the number and types of equipment used.

Checklist for self-record of pain-related nursing activities

A chart was developed for the ward nursing staff to self-record the length of time they took to perform a number of activities associated with pain management during the first 24 hours following surgery. The research team, in collaboration with the ward nursing staff, identified four main types of pain-related nursing activities for this chart. Pilot testing on two subjects led to clarification of the wording of the types of activity included in the chart. This self-recording started after the subjects arrived at the ward and lasted for 24 hours from commencement. The staff costs were based on the midpoint of the 7-point, Hospital Authority pay scale for registered nurses.

Amount of analgesia

The research assistant recorded the total amount of analgesic used after surgery from each patient's medical records following her discharge from hospital. This information was collected to calculate the cost of drugs used in pain management.

Equipment

All equipment associated with PCA and IM injection types of pain management were included in cost calculations. The PCA costs were infusion pumps, morphine cartridge, angiocatheters, and batteries. On the other hand, the cost calculation for IM analgesia included the syringes, needles, morphine, and swabs.

Results

One hundred and twenty-five women were recruited (mean [standard deviation] age, 44.4 [9.20] years). The intervention and control (IM) groups were similar in age, preoperative anxiety, and health locus of control levels. Women receiving IM pain management had significantly higher resting pain (t [123]=5.35, $P<0.001$) and non-resting pain (t [123]=3.99, $P<0.001$) [Fig 1].

Patients receiving PCA had lower pain levels at rest over 24 hours (Fig 1) and on deep breathing and coughing (Fig 2) compared with those on IM pain relief.

The PCA group used significantly more morphine than the IM group (t [123]=4.16, $P<0.001$), were more satisfied with their pain relief (t [123]=5.87, $P<0.001$), and of the common side-effects of nausea, vomiting, dizziness and itchiness, only nausea was more severe ($\chi^2=5.20$, $P<0.05$). No respiratory depression was observed in either group. There were no significant differences in the time

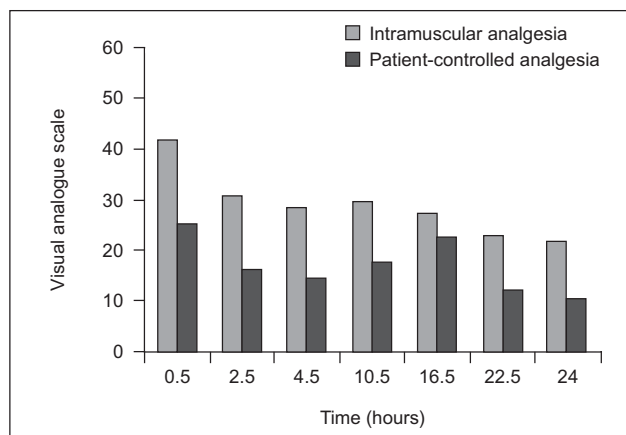


Fig 1. Level of pain at rest over 24 hours

Pain measured using visual analogue scale (mm from left hand side of scale)

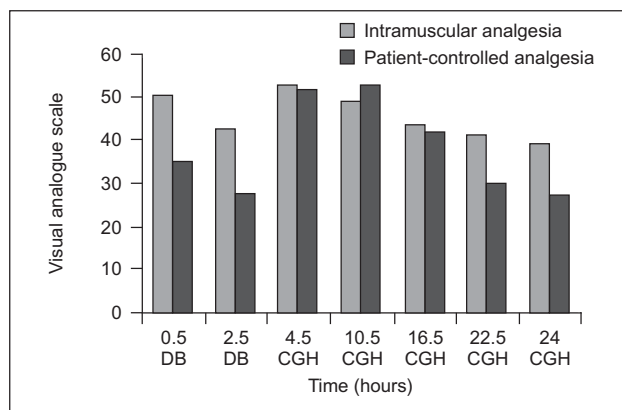


Fig 2. Level of pain on deep breathing (DB) or coughing (CGH) over 24 hours

Pain measured using visual analogue scale (mm from left hand side of scale)

Table. Cost analysis

Patient-controlled analgesia (PCA) variables, n=62	Total cost per patient (HK\$)	Intramuscular variables, n=63	Mean total cost per patient (HK\$)
Equipment (per patient)		Equipment	
PCA machine (per patient)	5.00	Syringe (2.5 mL)	1.43
Intravenous tubing set	5.03	Morphine (15 mL)	8.02
3-Way stopper	2.90	Alcohol swab	0.17
Reflux valve	4.10		
Battery	5.50		
Angiocatheter #20	8.00		
Syringe (20 mL)	0.36		
Tegaderm + Micropore	0.80		
Ampoules of morphine	19.00		
Normal saline (140 mL)	6.75		
Large cartridge for Morphine	85.00		
Metoclopramide 10 mg	2.80	Metoclopramide 10 mg	2.16
Subtotal	145.24	Subtotal	11.78
Staff		Staff	
Nursing staff per 24 hours	794.20	Nursing staff per 24 hours	846.56
Total	939.44	Total	858.34

taken for all nursing activities between the two groups ($t[109]=0.98$, $P>0.05$; mean [standard deviation], 25.41 [21.88] minutes).

Cost analysis

Pain management using PCA was HK\$81.10 more expensive per patient but was more effective than IM management at reducing pain and increasing satisfaction. As shown in the Table, the mean drug and equipment cost per patient for the PCA group was much higher than that for the IM group (HK\$145.24 vs HK\$11.78) while the nursing time taken for PCA pain-related activities over the 24-hour period was slightly less.

Discussion

Although PCA was more costly, patients using it reported better pain control than those receiving on-demand IM morphine, as found in previous studies.¹¹ The patients using PCA were more satisfied, had less pain, fewer side-effects,

and more control over their pain management than the IM patients.

Both groups experienced similar side-effects but the patients in the PCA group reported more nausea. We found that IM pain management incurs higher labour costs, as reported by earlier studies³ but higher equipment and drug costs meant the improvement in pain scores reported by the PCA group cost an additional HK\$81.10 per patient.

The main limitations of this study were: the lack of adherence by patients to the protocol for IM pain management; the timing of pain assessments; using patient recall over 8-hour periods in the first 24 hours post-surgery to collect data on the effects; and the method of collecting nursing time data.

Acknowledgement

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