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# Pharmacist Educational Intervention in Intravenous Patient-Controlled Analgesia is Associated with Decreased Postoperative Pain

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## Research Article

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**ABSTRACT**

**Background:** Perioperative pain management reduces patient suffering throughout the surgery process. Patient-controlled analgesia has become a common technique for postoperative pain management, although in some cases, a patient's lack of understanding of the treatment results in a decrease of its efficacy. Therefore, we examined the effects of a pharmacist intervention in acute pain control.

**Methods:** In this study, patients who underwent artificial joint replacement at our orthopedics department between January 2013 and March 2014 were enrolled on a continuous basis. Seventy patients were eligible. The intervention comprised pre- and postoperative instruction on intravenous patient-controlled analgesia (IV-PCA) and ensured patients' understanding of the rescue dose administration procedure. We retrospectively investigated whether a pharmacist intervention improved the Numeric Rating Scale (NRS) pain scores and the length of hospital stays.

**Results:** The mean NRS score on postoperative day 1 was 3.8 ± 2.4 in the non-pharmacist intervention group and 2.3 ± 1.8 in the pharmacist intervention group, indicating a statistically significant difference between groups ($p$<0.01). The average length of hospital stays was 22.6 ± 6.2 days and 22.3 ± 6.0 days in the non-pharmacist intervention group and the pharmacist intervention group, respectively; however, this was not a statistically significant difference ($p$=0.44).

**Conclusion:** Interventional education provided by pharmacists during the perioperative acute pain control phase improved patient understanding of IV-PCA usage and reduced NRS scores during the most painful postoperative period.

## INTRODUCTION

According to recent reports, interventions by perioperative management teams in postoperative acute pain management improves pain score [1-5]. Although pharmacist interventions in perioperative antibacterial drug management [6,7] or glycemic control [8] have been reported, no study has investigated pharmacist interventions in pre- and post-operative acute pain control.

In postoperative pain management, it is recommended to combine various treatments including intravenous analgesia, epidural anesthesia, and non-steroidal anti-inflammatory drugs, providing a tailored intervention for each patient. Among these

interventions, intravenous patient-controlled analgesia (IV-PCA), in which patients can self-administer an analgesic by pressing a rescue button allowing them to control their pain level themselves, is a widely used technique [3,4,9-12]. Unfortunately, lack of patient understanding of this technique decreases its effectiveness. Pain is unbearable for postoperative patients [4] and it has been reported that adequate postoperative pain management allows smooth sputum excretion and reduces complications such as pulmonary infections and embolisms, while also improving the quality of daily activities and shortening the length of hospital stays [2,4,10,13,14]. In this study, we performed a retrospective analysis to examine whether a pharmacist intervention improves postoperative pain scores. In addition, the effect of pharmacist interventions on the length of hospital stays was investigated, along with the frequency of adverse effects.

## MATERIALS AND METHODS

### Patient Population

Patients who underwent artificial joint replacement and used IV-PCA between January 2013 and March 2014 were enrolled in the study on a continuous basis. Patients were excluded if they had artificial joint replacement twice during one admission; used opioids, Alzheimer's, or dementia drugs prior to surgery; had pain at rest; had difficulty understanding the NRS; had a poor understanding of the preoperative instructions provided by the pharmacist; or had difficulties with the use of rescue doses.

### Pain Control Protocol

All patients received a nerve block before surgery, and IV-PCA was started after the completion of surgery. A Coopdech® Syrinjector® PCA mobile disposable infusion pump (Daiken Iki Corporation, Osaka, Japan) was filled with 60 mL of a solution containing 40 mL of physiological saline and 1 mg of fentanyl citrate (0.5 mg/10 mL). The continuous infusion rate was set at 1 mL/h, the rescue dose was set as 1 mL, the lockout time was 10 min, and six rescue doses were allowed per hour. The oral analgesics loxoprofen sodium hydrate and acetaminophen or intravenous analgesic flurbiprofen axetil were administered as needed. The attending physician determined the dosages of these "as needed" drugs, and the nurse upon administration selected drugs.

In the pharmacist intervention group, multiple pharmacists belonging to the orthopedics ward visited the patients at their bedside before surgery to give them instructions on how to use the PCA device and provide them with an educational brochure **(Figure 1)**. The pharmacist checked the patient's depth of understanding and asked them to demonstrate their capability to press the rescue button on the device. Pharmacists visited patients within 24 h of their return from the operation room to reaffirm their depth of understanding and to monitor their condition using the monitoring sheet **(Figure 2).**

1. Name
2. Drug efficacy
3. Continuous administration of specified dose
4. Painkiller is added when the button is pressed (use of the device)
5. Use the device once pain is felt, do not refrain from administering rescue drug
6. No additional drug is administered until 10 minutes has elapsed
7. Nausea and vomiting are commonly experienced
8. Antiemetic medication is available
9. Breathing may be slowed and itching may occur
10. Drug administration may be interrupted or discontinued
11. Other painkillers can be used in addition to the rescue drug

**Figure 1.** Preoperative teaching content.

1. Pain region
2. NRS
3. Timing of pain
4. Pain behaviour
5. Presence or absence of nausea/vomiting
6. Drug intake
7. Antiemetic medication use
8. Presence or absence of sleepiness
9. Respiratory rate
10. Naloxone use
11. Use of other analgesics

**Figure 2.** Postoperative monitoring items.

Patients in the controlled group received instructions on IV-PCA from another member of the medical staff (an anesthesiologist, a physician, or a nurse). All patients received usual pharmacist support as necessary.

### Evaluation

Patient information was retrospectively collected from the electronic medical records. The day of surgery was regarded as postoperative day 0 (POD 0) and the following days were POD 1, POD 2, up to POD 6. Ward nurses measured vital signs and collected NRS data in the morning, at noon, and in the evening. We investigated pain scores up to POD 6 to monitor changes in pain with use of IV-PCA. The primary endpoint was the mean NRS pain score from POD 0 to POD 2 and the secondary endpoint was the length of the hospital stay.

### Statistical Analysis

We used STATA version 11 (StataCorp LP, College Station, TX) for our quantitative analysis. Student's t-test and Mann-Whitney U test were used for univariate analyses. Taking NRS scores on POD 1 as the outcome and whether or not there was a pharmacist intervention as the predictor, a multivariate linear regression was performed while controlling for confounders (sex, age, surgery type, and body mass index). Categorical data were evaluated using Pearson's chi-square test. Statistical significance was attained when the *p*-value was less than 0.05.

### Ethics Approval

This study was approved by the Kameda General Hospital Clinical Research Review Committee.

## RESULTS

Among the 87 patients enrolled, 70 patients were eligible. Of the ineligible patients, 16 underwent two surgeries during a single admission period and were excluded because pain from the first surgery had not subsided by the second surgery, and one patient had a history of opioid use prior to surgery, indicating that the postoperative dose of IV-PCA was likely to be insufficient. No patients received Alzheimer's medications, had pain at rest, had difficulty understanding NRS, had a poor understanding of instructions, or had a problem with the use of rescue doses. None of the patients had a history of cancer. There were no statistical differences in patient backgrounds between the two groups **(Table 1).**

**Table 1.** Patient characteristics.

| | Non-intervention group (n=35) | | | Intervention group (n=35) | | |
|---|---|---|---|---|---|---|
| | **Mean (or count)** | **±S.D. (or %)** | **Range** | **Mean (or count)** | **± S.D. (or %)** | **Range** |
| Age (years) | 68.2 | ± 8.0 | 48-83 | 66.2 | ± 7.2 | 51-75 |
| Sex (male/female) | 6/29 | 17/83 | | 7/28 | 20/80 | |
| Height (cm) | 154.7 | ±7.8 | 139.5-173.4 | 153.9 | ± 7.0 | 139.7-172.2 |
| Weight (kg) | 61.3 | ±10.7 | 45.1-81.0 | 59.6 | ± 10.2 | 40.2-78.8 |
| Operative TKA*/THA** | 24/11 | 69/31 | | 25/10 | 71/29 | |
| General/Spinal anesthesia | 29/6 | 83/17 | | 28/7 | 80/20 | |
| IV-PCA time of use (hour) | 34.0 | ± 1.7 | | 30.7 | ± 11.4 | |

Note: *TKA: Total Knee Arthroplasty
**THA: Total Hip Arthroplasty

The mean NRS scores on POD 1 were 3.8 ± 2.4 and 2.3 ± 1.8 in the non-pharmacist intervention group and the pharmacist intervention group, respectively. The difference between the two groups on POD 1 was statistically significant ($p<0.01$). On the other PODs, the NRS scores were lower in the pharmacist intervention group although there were no statistically significant differences between groups **(Figures 3 and 4).** The number of "as needed" analgesics used in addition to IV-PCA was lower in the pharmacist intervention group than the non-pharmacist intervention group. Each patient in the intervention group used painkillers on 3 occasions during the post-operative period (PODs 0-6), compared to 11 times in the control group ($p=0.08$). The number of rescue doses was higher in the intervention group (19.0 ± 10.8) than in the non-intervention group (14.4 ± 11.0) ($p=0.07$). The results of a multivariate linear regression showed that the presence or absence of a pharmacist intervention was the most important factor in ameliorating NRS scores on POD 1 ($p<0.01$) **(Table 2).** The average length of the hospital stays was 22.6 ± 6.2 days and 22.3 ± 6.0 days in the non-pharmacist intervention group and the pharmacist intervention group, respectively. There were no differences between the non-pharmacist intervention group and the pharmacist intervention group ($p=0.44$).

## DISCUSSION

There have been reports regarding the effectiveness of an acute pain team in perioperative pain management. However, no studies have specifically examined the effect of pharmacist interventions. Acute pain management after artificial joint replacement is considered crucial [9,14-17], and a pre- and postoperative pharmacist intervention improved the pain score in the acute phase.

IV-PCA has been widely used in Japan and mobile disposable devices have become popular. This single-use PCA requires

no initial investment and is program error-free because of the easy drug filling procedure. Nevertheless, some disadvantages exist such as difficulty pressing the rescue button; making sure patients understand how to use the device is highly important. Furthermore, a sufficient analgesic effect cannot be obtained without the appropriate use of PCA [18-22]. In this study, the number of rescue doses increased in the pharmacist intervention group, suggesting that a pre- and postoperative pharmacist intervention improved patient understanding of IV-PCA and its procedures, leading to a statistically significant improvement in pain scores on POD 1. We enrolled patients who were hospitalized in our orthopedics department for artificial joint replacement. The majority of the patients were elderly, with a mean age of 67.2 years, and 81% of them were women. Gender and age are factors known to affect the pain score and opioid dose needed [10,23,24]. Thus, we used multiple regression analysis to determine the impact of confounding factors. The results of a multivariate linear regression of factors effecting NRS scores on POD 1 indicate that the presence or absence of a pharmacist intervention was the most influential. In the pharmacist intervention group, pain scores improved at all postoperative periods. The differences in NRS scores between the two groups gradually decreased through POD 3 to 6. This may be attributable to the completion of IV-PCA treatment.

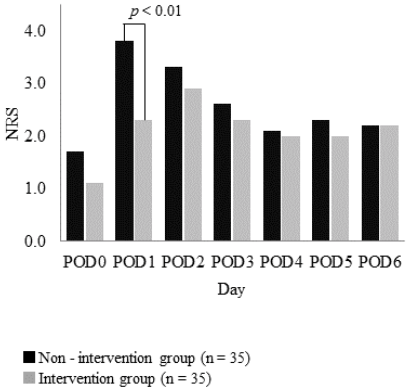


**Figure 3.** Average NRS values. Significance was determined using the Mann-Whitney *U* test.

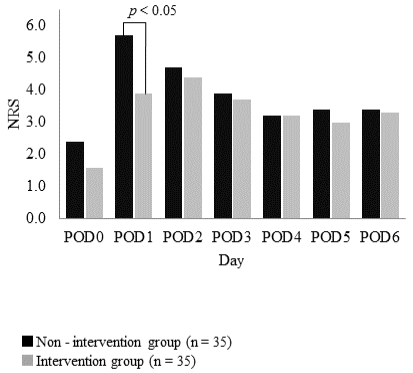


**Figure 4.** Maximum NRS values. Significance was determined using the Mann-Whitney *U* Test. The difference between the two groups on POD 1 was statistically significant ($p$=0.012).

**Table 2.** Analysis of background factors affecting the NRS (POD1).

| Factors | *β* | *p*-value | 95% CI |
|---|---|---|---|
| Pharmacist intervention | -1.554 | 0.004 | (-3.108 to -2.064) |
| Male | -0.258 | 0.703 | (-2.686 to -0.515) |
| Age | -0.051 | 0.151 | (-0.139 to -0.101) |
| *THA | -0.017 | 0.977 | (-2.378 to -0.035) |
| **BMI | -0.074 | 0.317 | (-0.292 to 0.148) |

**Note:** *THA: Total Hip Arthroplasty (other than Total Knee Arthroplasty)
**BMI: Body Mass Index

A perioperative team intervention and multimodal analgesia are believed to improve the pain score and shorten the length of hospital stay [3,12,14,16]. However, this is still controversial, as studies have indicated that pain relief within the first 48 h after surgery is not an important factor in improving the time of symptomatic recovery and shortening the length of hospital stay [25]. In this study, no statistically significant differences were observed in the length of hospital stays between the two groups.

No statistically significant differences were observed in the incidences of adverse effects and subsequent measures taken **(Table 3).** With postoperative opioid use, the most frequently observed adverse events are nausea and vomiting [15,26,27]. In this study, postoperative nausea and vomiting were observed in 57% and 43% of patients in the non-intervention group and the intervention group, and loss of appetite occurred in 74% and 54% of patients, respectively. The possible cause of loss of appetite

in a large number of patients may be opioid use, anesthesia-induced nausea, or other unknown causes. It may be necessary to add antiemetic medication to IV-PCA.

**Table 3.** Incidence of common adverse events.

| | Non-intervention group (n=35) | Intervention group (n=35) | *p*-value |
|---|---|---|---|
| Nausea and Vomiting | 20 | 15 | 0.34 |
| Antiemetic | 11 | 9 | 1.00 |
| Loss of appetite | 26 | 19 | 0.10 |
| Sleepiness | 1 | 0 | 1.00 |
| Respiratory depression | 0 | 0 | 1.00 |
| Other | 0 | 1 | 1.00 |

Patients who experienced any adverse effects during IV-PCA were counted. A metoclopramide injection (10 mg) or prochlorperazine intramuscular injection (5 mg) was the antiemetic treatment used. Loss of appetite was defined as a 50% decrease in food intake under IV-PCA treatment. Respiratory depression was characterized as less than 8 breaths per minute. Itching and device issues were included in other adverse effects. The incidence of common adverse events is evaluated using the Pearson chi-square test with Yates continuity correction

This was a pilot study; therefore, the small sample size is one limitation. This was a retrospective, single-center study, which are also limitations. As such, these results may not be generalizable to the overall population.

## CONCLUSION

Postoperative pain in patients who underwent THA/TKA procedures was improved by a pharmacist educational intervention on PCA.

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## COMPETING INTERESTS

The authors have no relevant conflicts of interest to disclose.

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