

Retrospective evaluation of patient-controlled analgesia (PCA) practices in a tertiary hospital

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ABSTRACT

Aims: This study aimed to evaluate the patient-controlled analgesia (PCA) methods applied in a tertiary health care institution, the profiles of the practitioners and the patients involved, and the factors affecting the application process.

Methods: The data of the patients who were administered PCA in 2023 and 2024 were analyzed retrospectively. The demographic information of the patients, the types of PCA applications, in which clinics they started and for what purpose, who started the treatment, complications, reasons for termination, and duration of use were evaluated.

Results: 52.5% of the 1.040 patients included in the analysis were female, with a mean age of 55.7 ± 17.75 years. The most common PCA method was epidural (53.7%), and the clinic where it was applied the most frequently was the orthopedics clinic. The complication rate was low, and the most common complication was found to be nausea-vomiting. The duration of PCA use showed a significant difference according to the type of application, and the longest duration was observed in peripheral nerve (PN) catheter PCA ($p < 0.001$). Epidural PCAs were mostly initiated by resident physicians, while PCAs applied with PN catheters were initiated by academic staff.

Conclusion: PCA is an effective and safe method in postoperative pain management. These retrospective findings provide important contributions to the evaluation and standardization of existing protocols.

Keywords: Patient-controlled analgesia, pain management, clinical supervision

INTRODUCTION

Pain is a health problem that is felt in any part of the body, affects the quality of life of the individual, and is affected by many factors.¹ Especially inadequate postoperative pain treatment leads to a decrease in patient satisfaction in the early period, prolongs the healing process, and increases the length of hospital stay, as well as increasing the risk of developing chronic pain in the long term.^{2,3}

Patient-controlled analgesia (PCA) is used to treat acute, chronic, postoperative, and labor pain. PCA is an effective and widespread pain management method that was defined as a concept in 1965 and entered clinical practice in 1982.^{4,5} PCA patients are provided with the opportunity to use the drugs prescribed by their doctor within safe limits according to the severity of the pain they feel.⁶ Studies have shown that

PCA is associated with high patient satisfaction as well as early mobilization, reduced side effects due to opioid use, and reduced length of hospital stay due to effective analgesia.^{4,7}

It can be administered in many ways, most commonly by intravenous (IV) and epidural catheters placed around the subcutaneous, intramuscular, rectal, oral, and peripheral nerves (PN). In fact, noninvasive PCA models such as the transdermal system and the sublingual tablet system have been developed recently.^{8,9}

With this research, we aimed to define the PCA application habits and patient profile in the anesthesia clinic of a tertiary hospital. In addition, we sought an answer to the question of how we can increase the effectiveness of future

PCA applications by determining the factors affecting the initiation and termination of PCAs.

METHODS

The study was conducted with the permission of the Gülhane Scientific Researches Ethics Committee of the University of Health Sciences (Date: 08.04.2025, Decision No: 2025-220). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Patients who were administered PCA in the Anesthesiology and Reanimation Clinic in the Gülhane Training and Research Hospital in 2023 and 2024 were retrospectively examined after the approval of the local ethics committee. The data were obtained from the hospital registration system and PCA follow-up books kept by our clinic. The age and gender of the patients, American Society of Anesthesiologists (ASA) scores, types of surgery and clinics performed, PCA administration route, whether there is non-protocol drug use in PCA, the status of the doctor who initiated the application, the presence of complications during the application, and, if any, the duration of use and the reasons for PCA termination were recorded. Patients with incomplete data were excluded from the study.

In our clinic, three main types of PCA with predetermined protocols are used. Patients who are administered PCA are followed up by the pain team, and the patient's name, surname, clinic name, type of surgery, type of PCA administered, starting and ending times, starting doctor's ID, whether there are complications, and the reasons for termination are recorded in the pain book. Our pain team in our hospital consists of an anesthesiologist experienced in pain, a lecturer, an anesthesia resident physician, and an anesthesia technician. IV PCA is used at a contramnal 5 mg/ml concentration, a 5 mg/ml infusion dose, a 20 mg bolus dose, a 30-minute lockout period, and a four-hour limit of 60 mg. In the epidural PCA protocol, bupivacaine at a concentration of 0.125% is administered at a 4 ml infusion dose, a 5 ml bolus dose, a 30-minute lockout period, and a four-hour limit of 30 ml. In the PCA protocol performed with a PN catheter, Bupivacaine at a concentration of 0.125% is administered at a 4 ml infusion dose and a four-hour limit of 20 ml, without a bolus dose and lockout period.

Statistical Analysis

Descriptive statistics for continuous variables were presented as mean, standard deviation, median, minimum, and maximum values, while numbers and percentages were used for discrete data. The Shapiro-Wilk test was used to examine the conformity of continuous data to normal distribution.

Chi-square test was used for group comparisons of nominal variables (cross-tables). The Kruskal-Wallis variance analysis was employed to compare drug use durations in PCA types. The Kruskal-Wallis multiple comparison test was used to determine which groups caused the difference.

IBM SPSS version 20 (Chicago, IL, USA) program was used in the evaluations, and $p < 0.05$ was accepted as a statistical significance value.

RESULTS

A total of 1.084 patients were administered PCA between 2023 and 2024, and the data of 48 patients were not included in the evaluation because they were incomplete. 52.5% of the patients were female, 47.5% were male, and the ASA score of 54.3% was recorded as "3". The mean age was calculated as 55.70 ± 17.75 years; the youngest patient was 10 years old, and the oldest patient was 88 years old. The decision to start PCA was mostly made by resident doctors (59.3%) (Table 1). The clinic with the highest number of PCA applications was the orthopedics clinic with 35.6% (Figure 1). When the types of PCA were examined, it was determined that 53.7% of the patients were administered PCA via epidural, 42.6% via IV, and 3.8% PN PCA (Figure 2).

Table 1. Characteristics of patients who were administered PCA

	Mean $\pm$ SD median (min-max)	
Age (years)	55.70 $\pm$ 17.75 58 (10-88)	
	n	%
Gender		
Female	546	52.5
Male	494	47.5
ASA		
1	76	7.3
2	395	38.0
3	565	54.3
4	4	0.4
Doctor starting PCA		
Resident Dr.	617	59.3
Specialist Dr.	301	29.0
Academic staff	122	11.7

PCA: Patient-controlled analgesia, SD: Standard deviation, Min: Minimum, Max: Maximum, ASA: American Society of Anesthesiologists Score, Dr: Doctor

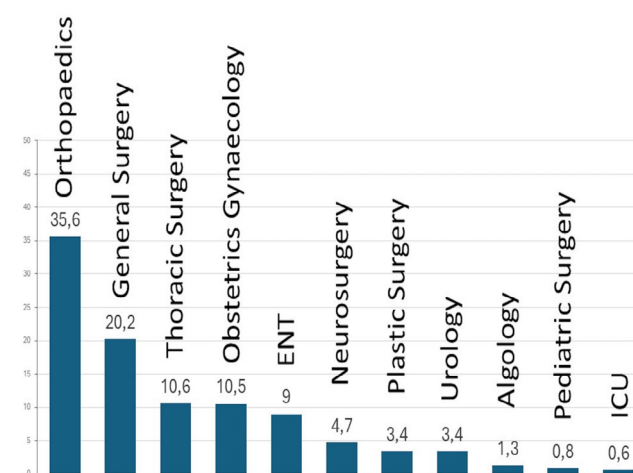


Figure 1. Distribution of PCA usage across clinical departments
Percentage of clinics' PCA usage rates are stated as. PCA: Patient-controlled analgesia

The complication rate was generally low, and it was found that 87.8% of the patients did not develop any complications. The most common complication was nausea and vomiting, with 6.3%. The complication rates of PCA types were similar.

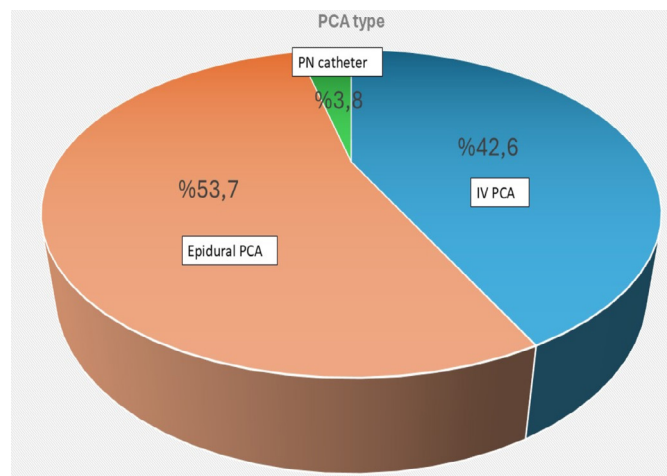


Figure 2. Distribution of PCA types

IV: Intravenous, PCA: Patient-controlled analgesia, PN: Peripheral nerve

When the types of PCAs started according to the clinics were investigated, it was seen that IV PCA was used the most in the general surgery clinic (66.2%), epidural PCA was used the most in the orthopedics clinic (71.1%), and epidural PCA was used the most in the gynecology and obstetrics clinic (82.6%). It was observed that the most commonly performed operations in 1.028 patients for whom PCA was started in the postoperative period were gastro-intestinal system operations with a rate of 18.9% (194 patients), Total Knee Prosthesis with a rate of 17% (175 patients), and Total Hip Prosthesis with a rate of 10.6% (109 patients).

The most common cause of termination in all types of PCA was pain termination (Table 2). When the three types of PCAs were compared in terms of their duration of use, a statistically significant difference was found between them ($p < 0.05$). It was observed that the duration of PN PCA use was the longest ($p < 0.001$) (Table 3).

Table 2. Reasons for PCA termination by type

	IV PCA		Epidural PCA		PN PCA	
	n	%	n	%	n	%
Reasons for termination						
Termination of pain	168	37.9	400	71.7	16	41.0
Block development	2	0.5	43	7.7	0	0
Nausea/vomiting	28	6.3	8	1.4	0	0
Refusal by the patient	16	3.6	3	0.5	0	0
Not preferred by the surgeon	17	3.8	5	0.9	1	2.6
Infection at the application site	0	0	4	0.7	5	12.8
Catheter dislocation	3	0.7	37	6.6	5	12.8
Hypotension	0	0	3	0.5	0	0
Discharge	42	9.5	21	3.8	1	2.6
Expiration of working time	112	25.3	12	2.2	9	23.1
Being ineffective	44	9.9	16	2.9	2	5.1
Respiratory depression	7	1.6	0	0	0	0
Numbness	0	0	3	0.5	0	0
Other	4	0.9	3	0.5	0	0

IV: Intravenous, PCA: Patient-controlled analgesia, PN: Peripheral nerve

Table 3. Comparison of drug use durations between PCA types

	IV PCA	Epidural PCA	PN PCA	P
	Mean±SD median (min-max)	Mean±SD median (min-max)	Mean±SD median (min-max)	
Duration of drug use	1.66±1.83 1 (0-29)	1.81±1.73 2 (0-7)	3.41±1.74 3 (0-7)	<0.001 ^b

PCA: Patient-controlled analgesia, SD: Standard deviation, Min: Minimum, Max: Maximum, IV: Intravenous, PN: Peripheral nerve, b: Kruskal Wallis variance analysis

A significant relationship was found between the status of the doctor initiating PCA and the types of PCA ($p < 0.001$). Resident doctors initiated epidural PCA more frequently, while specialists and academic staff performed IV PCA applications more frequently. PN PCA catheter was most often initiated by the academic staff. In addition, those who used non-protocol drugs the most were the academic staff ($p < 0.01$).

The rate of non-protocol drug use was found to be higher in PN PCA use than both IV and epidural PCA types ($p < 0.001$). When PCA types were compared in terms of complications, it was observed that there was no significant difference between them ($p > 0.05$). However, in patients who were administered epidural PCA, a difference was found between the complication rates according to the status of the physicians who started the treatment ($p < 0.05$). The complication rates of resident physicians who started the treatment in patients using epidural PCA were found to be higher than those of specialist physicians ($p > 0.05$).

DISCUSSION

In recent years, awareness about the importance of pain management has increased. Pain management practices based on patient participation stand out as a determining factor in terms of the success of quality management systems in surgical processes.¹⁰ The effectiveness of PCA in the treatment of acute, chronic, postoperative, and labor pain has been demonstrated in various studies.^{3,7,11} PCA can be administered in many ways, such as IV, through an epidural or PN catheter, or transdermally and by using different medications.⁴ Health institutions often determine and implement specific PCA protocols with pain teams involving anesthesiologists.⁶ In our hospital, which is a tertiary health institution, PCAs are followed up by a pain team including anesthesiologists, technicians, and nurses. With this study, we aimed to increase awareness of the clinical applications of PCA by examining the PCA applications applied in our hospital over a two-year period.

We observed that 1.040 patients were started to be administered PCA in our hospital over a two-year period, and it was determined that the number decreased compared to a two-year study conducted in our clinic in 2009.¹² We thought that this may be due to the more widespread use of various USG-guided nerve blocks for multimodal analgesia.

Administering opioids through IV PCA is an effective method that increases the quality of life of the patient,

especially in patients who cannot use oral drugs or experience severe pain despite oral drugs.^{13,14} It has also been shown that PCA offers obstetric and analgesic advantages in painless delivery practices.¹⁵ However, in our hospital, we found that PCAs are used more for postoperative pain, especially after orthopedic surgeries, than for chronic pain treatment and labor analgesia. When we examined the literature, we found that PCAs were most commonly used for postoperative analgesia, similar to our results.⁸ When we examine retrospective studies conducted on PCA use in Türkiye, we see that it is most commonly used for postoperative pain management after orthopedic surgeries, similar to our results. Nevertheless, while epidural PCA was found to be the most commonly used type of PCA in our study, IV PCA was determined to be the most commonly used type in those studies.^{12,16,17}

Although there is no clear information about the duration of use of PCAs, the person who decides on the duration is the doctor who starts the treatment and follows up on the effectiveness and complications of PCA application.⁶ In our clinic, the duration of PCA use varied according to the types, with an average of one day for IV PCA, two days for epidural PCA, and an average of three days for PCAs administered through the PN catheter. We think that the reason for the shorter duration of IV PCA use is that it is preferred more in cases whose pain does not persist for a very long time in the postoperative period.

The most common complication seen during PCA use in this two-year period in our hospital was nausea-vomiting. When we look at the results of a study examining the use of PCA in our hospital in 2009, we see that the most common complication causing PCA termination was nausea and vomiting.¹² In a retrospective study conducted by Senayli et al.,¹⁶ the most common complication encountered in PCAs was found to be sedation. We think that this result was caused by the use of pethidine and morphine in IV PCA protocols. When the literature is examined, it is seen that the most common complications after the use of PCA are nausea-vomiting, sedation/drowsiness, itching, and urinary retention; however, no serious complications are generally encountered as a result of the follow-ups performed by the pain teams.^{12,16,17} Complications such as local anesthetic toxicity, catheter site infection, short-term or long-term nerve damage, allergy, and systemic infection may also occur, depending on the drug used with these complications, the route of use, and the dosage. Complications that may be encountered in PCAs can be minimized by patient follow-up at appropriate intervals.^{4,18,19}

In our study, we investigated the status of doctors who started PCA administration, which has not been examined before, and whether this had an effect on PCA preference and complications. While most of the epidural PCAs in our hospital were started by resident doctors, we found that PCAs were mostly started by the academic staff through a PN catheter. We think that this result stems from the tendency of resident doctors to learn the epidural anesthesia technique, which is one of the cornerstones of regional anesthesia, in their educational process and the fact that PN catheter application requires more experience and knowledge. When compared in terms of complications, more complications,

such as block development and numbness, were encountered in PCAs started through epidural catheters placed by resident doctors compared to those started by specialist doctors. We believe that this is caused by the difference in experience in placing the epidural catheter.

Limitations

The limitations of our study were that it was retrospective, did not include postoperative pain scores, and was single-centered. In parallel with the developments in today's technology, we think that prospective, multicenter studies including different PCA models (such as new generation non-invasive PCA systems) will contribute to the literature. Moreover, data on analgesic satisfaction and long-term outcomes were not included, which could be addressed in future studies.

CONCLUSION

PCA is one of the effective methods in pain relief with less anxiety and higher patient satisfaction, providing better pain control compared to conventional methods. It has been widely used, especially in the management of postoperative pain. However, PCA settings are often determined by institutional standards or individual clinician preferences. We think that such retrospective reviews will be useful in revising the protocols.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was conducted with the permission of the Gülhane Scientific Researches Ethics Committee of the University of Health Sciences (Date: 08.04.2025, Decision No: 2025-220).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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