Mini-CAT
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Evidence Based Medicine
12/15/2025

Clinical Question:
In adult post-operative total hip replacement patients, is patient-controlled analgesia (PCA) more effective than PRN intramuscular (IM) pain medication for postoperative pain management?

PICO Question:
P (Population): Adult post-operative total hip replacement patients
I (Intervention): Patient-controlled analgesia (PCA)
C (Comparison): PRN (as-needed) intramuscular pain medication
O (Outcome): Pain control effectiveness (e.g., pain relief, patient satisfaction, opioid use, recovery outcomes)

Search Strategy:
Outline the terms used, databases or other tools used, how many articles returned, and how you selected the final articles to base your CAT on.

Patient/Population	**Intervention**	**Comparison**	**Outcome**
Total hip replacement	Patient controlled anesthesia	PRN analgesia	Pain control
Post operative patients	PCA	As needed analgesia	Pain management
		IM pain medication	Patient satisfaction
		Intramuscular analgesia	Post op recovery

PubMed- 1,031 results

Articles Chosen for Inclusion (please copy and paste the abstract with link):

1. **Intravenous patient-controlled analgesia vs nurse administered oral oxycodone after total knee arthroplasty: a retrospective cohort study**
   - **Abstract:** Severe post-operative pain is common after total knee arthroplasty. Patient-controlled analgesia is an alternative method of pain management, whereby a patient administers his or her own pain medication. Patients seem to prefer this method over nurse-administered analgesia. However, it remains unclear whether patients using patient-controlled analgesia devices use higher or lower doses of opioids compared to

patients treated with oral opioids. This retrospective study examined 164 patients undergoing total knee arthroplasty. Post-operatively, 82 patients received oxycodone via intravenous patient-controlled analgesia devices, while the pain medication for 82 patients in the control group was administered by nurses. The main outcome measure was the consumption of intravenous opioid equivalents within 24 h after surgery. Secondary outcome measures were the use of anti-emetic drugs and the length of stay. Furthermore, we evaluated opioid-related adverse event reports. The consumption of opioids during the first 24 h after surgery and the use of anti-emetic drugs were similar in both groups. The median opioid dose of intravenous morphine equivalents was 41.1 mg (interquartile range (IQR): 29.5-69.1 mg) in the patient-controlled analgesia group and 40.5 mg (IQR: 32.4-48.6 mg) in the control group, respectively. The median length of stay was 2 days (IQR: 2-3 days) in the patient-controlled analgesia group and 3 days (IQR: 2-3 days) in the control group (p=0.02). The use of anti-emetic drugs was similar in both groups. The administration of oxycodone via intravenous patient-controlled analgesia devices does not lead to increased opioid or anti-emetic consumptions compared to nurse-administered pain medication after total knee arthroplasty. Patient-controlled analgesia might lead to shortened length of stay.
Link: https://pubmed.ncbi.nlm.nih.gov/33141110/

2. **The Effectiveness of Patient-Controlled Analgesia in Orthopedic Joint Replacements: A Systematic Review**
    - **Abstract:** Orthopedic joint replacement procedures, including total hip and knee arthroplasty, are crucial interventions for managing degenerative joint diseases and enhancing patients' quality of life. Postoperative pain management remains a critical challenge affecting recovery and outcomes. Recognizing pain management as pivotal in patient care, this systematic review evaluates the effectiveness of patient-controlled analgesia (PCA) in orthopedic surgeries. This systematic review synthesizes the current literature to assess PCA's role in orthopedic joint replacements. Studies focusing on pain relief, opioid consumption, hospital stays, rehabilitation outcomes, and patient satisfaction were analyzed. Significant findings were extracted from statistical analyses to evaluate PCA's efficacy compared to traditional pain management methods. PCA significantly improves postoperative pain relief ($p < 0.05$), leading to a 30% reduction in opioid consumption and a 20% shorter hospital stay on average compared to traditional methods. Additionally, patients using PCA reported higher satisfaction scores (85% vs. 65%) and demonstrated improved rehabilitation outcomes, enhancing overall recovery and quality of life post surgery. This review underscores PCA's effectiveness as a superior strategy for postoperative pain management in orthopedic joint replacements. By reducing pain, opioid use, and hospitalization duration and enhancing rehabilitation outcomes, PCA contributes significantly to improving patient outcomes and healthcare efficiency.
    - Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC11857533/

3. **Pain therapy following joint replacement.A randomized study of patient-controlled analgesia versus conventional pain therapy**

- Abstract: A prospective randomized trial in 42 patients undergoing elective total hip or knee arthroplasty under general anaesthesia was carried out to evaluate the efficacy of patient-controlled analgesia (PCA) versus demanded conventional pain therapy (CPT) for controlling postoperative pain. Four patients had to be excluded from the study (2 postoperative confusion, 1 elevated piritramid dosage caused by chronic pain therapy, 1 stressed by PCA pump handling). PCA group (n = 19) received piritramid via PCA pump, CPT group (n = 19) received tramadol (oral or intramuscularly) or piritramid intravenously. PCA or CPT was started in the intensive care unit. Pain was measured with a standard 100 mm visual analogue scale (VAS) for 60 h postoperatively. Over this period of time, no significant differences were found in the pain score of both groups, nor did the incidence of side-effects differ significantly. The PCA group required on average twice as much piritramid-equivalent than the CPT group ($P < 0.001$). Patient satisfaction was good in both groups, but significantly better in the PCA group ($P < 0.01$), although the measured postoperative individual pain scores were above the preoperatively determined individual subjective pain threshold in the majority of both groups. From these results we draw the conclusion that even if the patients feel satisfied by the pain therapy administered, the majority are objectively treated below their individual subjective pain threshold.
- Link: https://pubmed.ncbi.nlm.nih.gov/10447620/

4. **Patient controlled opioid analgesia versus non‐patient controlled opioid analgesia for postoperative pain**
   Abstract: Patients may control postoperative pain by self administration of intravenous opioids using devices designed for this purpose (patient controlled analgesia or PCA). A 1992 meta‐analysis by Ballantyne et al found a strong patient preference for PCA over non‐patient controlled analgesia, but disclosed no differences in analgesic consumption or length of postoperative hospital stay. Although Ballantyne's meta‐analysis found that PCA did have a small but statistically significant benefit upon pain intensity, a 2001 review by Walder et al did not find statistically significant differences in pain intensity or pain relief between PCA and groups treated with non‐patient controlled analgesia.
   Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC7387354/

5. **Patient-Controlled Epidural Analgesia or Multimodal Pain Regimen with Periarticular Injection After Total Hip Arthroplasty**
   Abstract: The optimal postoperative analgesia after primary total hip arthroplasty remains in question. This randomized, double-blind, placebo-controlled study compared the use of patient-controlled epidural analgesia (PCEA) with use of a multimodal pain regimen including periarticular injection (PAI). We hypothesized that PAI would lead to earlier readiness for discharge, decreased opioid consumption, and lower pain scores. Forty-one patients received PAI, and forty-three patients received PCEA. Preoperatively, both groups were administered dexamethasone (6 mg, orally). The PAI group received a clonidine patch and sustained-release oxycodone (10 mg), while the PCEA group had placebo. Both groups received combined spinal-epidural anesthesia and used an epidural pain pump postoperatively; the PAI group had normal saline solution, while the PCEA group had bupivacaine and hydromorphone. The primary outcome, readiness for discharge, required the discontinuation of the epidural, a pain score of <4 (numeric rating scale) without parenteral narcotics, normal eating, minimal nausea, urination

without a catheter, a dry surgical wound, no acute medical problems, and the ability to independently transfer and walk 12.2 m (40 ft). PAI did not decrease the time to discharge and was associated with higher pain scores and greater opioid consumption but lower ORSDS scores compared with PCEA. The choice for analgesic regimen may depend on a particular patient's threshold for pain and the potential side effects
Link: - https://pmc.ncbi.nlm.nih.gov/articles/PMC4430099/

Summary of the Evidence:

Author (Date)	Level of Evidence	Sample/Setting (# of subjects/studies, cohort definition etc.)	Outcome (s) studied	Key Findings	Limitations and Biases
Katarina Lahtinen et al. (2020)	Retrospective cohort study	Total subjects: 164 patients. Setting: HUS Helsinki University Hospital Patient Cohort: Patients who underwent Total Knee Arthroplasty (TKA) as a treatment for osteoarthrosis between 2016 and 2017. Inclusion/Exclusion Criteria: Patients were 75 years old or younger, had an American Society of Anesthesiologists (ASA) Physical Status classification level between I and III, and did	Primary Outcome: The total consumption of opioids during the first 24 post-operative hours, measured by intravenous morphine-equivalent doses. Secondary Outcomes: The use of anti-emetic medication. The Length of Stay (LOS) after the operation. Opioid-related adverse event reports were also evaluated.	Opioid Consumption (Primary Outcome): The median consumption of opioids during the first 24 hours after surgery was statistically similar in both groups. The median opioid dose was 41.1 mg (IQR: 29.5–69.1 mg) in the PCA group and 40.5 mg (IQR: 32.4–48.6 mg) in the control group (p=0.35). Opioid Variation: The interquartile range (variation) of opioid doses was significantly wider in the PCA group compared to the control group (p=0.005). This wider	Selection Bias: This is cited as the most important limitation due to the lack of randomization in the study design. Intervention Group Status: Patients in the PCA group were recruited from another randomized trial, potentially resulting in a more standardized treatment regimen for them than for the retrospectively selected control group. Blinding: Neither the participants nor the caregivers were blinded. Missing Variables: The study was unable to measure

		not use strong opioids before surgery. Exclusion criteria included renal insufficiency, liver failure, bilateral TKA, or the use of an epidural catheter or femoral nerve block in post-operative pain management. Groups: 82 patients received oxycodone via intravenous Patient-Controlled Analgesia (PCA) devices (Intervention group). 82 patients received oral pain medication administered by nurses (Control group).		variation may indicate that some control group patients did not receive sufficient pain medication, or some PCA patients took unnecessarily large doses. Anti-emetic Use: The use of anti-emetic drugs was similar in both groups (p=0.86). This suggests PCA did not increase the incidence of nausea or vomiting side effects. Length of Stay (LOS): The median LOS was statistically significantly shorter in the PCA group (2 days; IQR: 2–3 days) compared to the control group (3 days; IQR: 2–3 days) (p=0.02). Conclusion: Administering oxycodone via intravenous PCA devices does not lead to increased opioid or anti-emetic consumption compared to nurse-administere	key variables such as the intensity of pain, nausea, and patient satisfaction. Adverse Events: The sample size was not sufficient to conclude rare adverse events.

				d pain medication after TKA. PCA might lead to a shortened length of stay.	
J, Forst, et al.	Prospective randomized controlled trial	Total subjects: 42 enrolled (elective primary total hip or knee arthroplasty under general anaesthesia); 4 patients were excluded (2 postoperative confusion, 1 on chronic pain therapy, 1 unable to handle the PCA pump), leaving 38 patients (19 per group) in analysis. Setting: Orthopaedic Clinic, RWTH Aachen University Hospital, Germany. Patient Cohort: Adults undergoing elective THA or TKA under GA. Inclusion/Exclusion: Primary joint replacement patients; excluded if postoperative confusion, preexisting high-dose opioid therapy, or	Primary Outcome: Postoperative pain intensity measured by 100 mm visual analogue scale (VAS) over 60 hours. Secondary Outcomes: Total opioid consumption (piritramid-equivalent), incidence of opioid side effects, and patient satisfaction with pain management. Patient satisfaction was assessed separately.	No significant difference in mean VAS pain scores between PCA and CPT groups over 60 h (both groups reported moderate pain above individual thresholds) Side-effect rates (e.g. nausea, respiratory depression) were similar between groups. The PCA group used substantially more opioid: on average twice the piritramid-equivalent dose as the CPT group ($P < 0.001$). Patient satisfaction was higher with PCA (significantly more patients “very satisfied” in PCA vs CPT, $P < 0.01$), despite similar pain scores. The authors note that most patients in both groups remained above their preoperative pain tolerance thresholds	Small sample size (only ~19 patients per arm) limits statistical power. Ten percent of enrolled patients were excluded, potentially introducing attrition bias. The study was single-center and unblinded, with subjective pain and satisfaction measures. All patients were on general anaesthesia and treated postoperatively in an ICU setting, which may limit generalizability. The finding that both groups had VAS scores above pain thresholds suggests overall suboptimal analgesia in both arms. No long-term outcomes were assessed.

		inability to use the PCA device Groups: PCA group (n=19) received intravenous piritramid via a patient-controlled analgesia pump; Conventional Pain Therapy (CPT) group (n=19) received as-needed tramadol (oral/IM) or intravenous piritramid on demand. PCA or CPT was initiated in the ICU.			
Altamimi, R., et al. (2025)	Systemic Review of RCTs	Total subjects/studies: 11 RCTs consisting of 1,396 patients. Setting: multiple international clinical trials across the USA, Japan, China, UK, South Korea, Italy, and Czech Republic. Patient Cohort: male and female between ages of 19 to 96 undergoing orthopedic joint replacement, including total hip replacement. Inclusion Criteria:	Primary Outcomes: 1. Pain control/pain intensity- measured by visual analogue scale (VAS) or Numeric Rating Scale (NRS) 2. Opioid consumption (total postoperative dose used) Secondary Outcomes: 1. Patient satisfaction with pain management 2. Length of hospital stay time to mobilization 3. Side effects/adverse events related to analgesia (respiratory depression, sedation, nausea, vomiting)	1. PCA provides effective pain control after orthopedic joint replacement, with most studies reporting lower pain scores at rest and during mobilization compared to non-PCA methods. 2. Opioid consumption was often lower or more efficiently managed with PCA, although some studies reported similar total opioid use compared to other analgesic methods.	Heterogeneity of studies: included various types of joint replacements, not just total hip replacement, and various types of non-PCA treatments, not just IM. Variation in outcomes measured: pain was measured using different scales (VAS, NRS) at different points in time (immediately after surgery vs a few hours after vs 24-48 hours after) making direct comparison challenging.

		RCTs of patients who had joint replacements using a PCA as a pain-management method and reporting outcomes including pain control, opioid consumption, patient satisfaction, or hospital stay. <u>Exclusion Criteria:</u> Studies that were not RCTs, not involving joint replacement, and not using PCA. Non-pharmacological intervention only studies and those published in languages other than English were also excluded. <u>Groups:</u> PCA-based analgesia groups (unspecified IV PCA, IV morphine, IV fentanyl + droperidol, IV oxycodone, and sublingual sufentanil) Non-PCA based analgesia (IM opioid injections as needed, oral prolonged-release oxycodone-naloxone, continuous femoral nerve		3. Patient satisfaction was generally higher in PCA groups, reflecting greater control over pain management. 4. Side effects (nausea, vomiting, sedation) were reported across all groups, but PCA was generally well tolerated; differences were not consistently significant. 5. Hospital stay and mobilization time showed minimal differences between PCA and non-PCA groups, suggesting that analgesic methods did not strongly impact recovery duration.	<u>Sample Size:</u> Some RCTs used a limited number of patients which reduced statistical power. <u>Performance Bias:</u> unable to blind participants as patients control the delivery of analgesia in PCA and nurses/clinicians are aware of who is getting PCA vs non-PCA analgesia. <u>Selection Bias:</u> There were differences in the inclusion/exclusion criteria across the RCTs with some excluding older adults or patients with comorbidities.

		block, single-shot nerve blocks, IV acetaminophen, continuous epidural analgesia, multimodal analgesia)			
McNicol, Ewan, et al. (2015)	Systematic review of RCTs	Total subjects/studies: 49 randomized controlled trials totalling 3,412 postoperative adult patients (1,725 in PCA groups & 1,687 in non-PCA: IM, SC, IV, oral PRN) Setting: Inpatient postoperative hospital settings across the world (North America, Europe, Asia, Australia) Patient cohort: Adult post operative surgical patients (> 18 years old) including orthopedic, abdominal, gynecological, urologic, and cardiothoracic surgeries Inclusion criteria: Adults recovering from acute post-op pain, receiving systemic opioid analgesia,	The review assessed five major outcome categories: **Pain intensity (primary outcome):** Measured using Visual Analogue Scale (VAS); **Opioid consumption:** Measured as total opioid dose converted to IV morphine equivalents **Patient satisfaction:** Measured through self-reported satisfaction scores **Adverse effects:** Included nausea, vomiting, pruritis, sedation, respiratory distress **Functional/clinical outcomes:** Included length of hospital stay	**Pain intensity:** PCA resulted in slightly lower pain scores that non-PCA **Opioid consumption:** PCA users consumed more total opioid than non-PCA patients **Patient satisfaction:** PCA resulted in higher patient satisfaction than conventional IM, IV, SC, oral PRN administration **Adverse effects:** Pruritus was more common in PCA group; no clinically significant differences in other side effects **Functional/clinical outcomes:** No significant difference in groups in length of hospital stay	Multiple RCTs included were unblinded —> performance bias and detection bias High heterogeneity across studies: difference in types of surgery, PCA settings, doses and routes of opioids Variability in non-PCA control groups: control groups received IM, SC, IV bolus, oral PRN opioids. These are not equivalent treatments, making comparisons uneven and limiting generalizability Incomplete reporting in included RCTs: many trials failed to report details of randomization or whether intention-to-treat analysis was performed. This creates risk of

		randomized to PCA opioid therapy or non-PCA <u>Exclusion criteria</u>: Chronic opioid users, chronic pain diagnoses, pediatric patients, non-postoperative pain conditions <u>Groups</u>: PCA opioids: primarily morphine, fentanyl, hydromorphone, and tramadol Nurse administered PRN opioids: IM, SC, IV morphine, meperidine, tramadol, codeine, and oral oxycodone. Standard multimodal analgesia such as acetaminophen and NSAIDs were also allowed.			selection bias and attrition bias.
Jules-Elysee et al. (2015)	Randomized control study	<u>Total subjects:</u> study involved 90 patients <u>Setting:</u> Took place at a university-affiliated orthopedic teaching hospital for special surgery in NY.	<u>Primary Outcome:</u> Time to readiness for discharge which was defined by a number of criteria including a pain score of <4 without IV opioids for 4 hours, being able to take PO, minimal nausea, mobility and catheter removed.	<u>Pain Control:</u> No overall difference was found in pain at rest During ambulation PCEA provided notable reduction in pain	<u>Comparator Mismatch:</u> The comparator was peri-articular infiltration + multimodal regimen, not IM PRN analgesia. <u>Route of Analgesia:</u>

		Study Design: Prospective, randomized, double-blind, placebo-controlled clinical trial Patient Cohort: Consisted of adults 50-80 years old undergoing primary unilateral total hip arthroplasty (THA) for osteoarthritis Inclusion Criteria: Adult patients scheduled for primary THA ASA physical status I–III with a diagnosis of osteoarthritis Exclusion Criteria: Chronic opioid use >3 months, hepatic or renal failure, allergy to study medications, ASA class IV, contraindications to epidural anesthesia, revision or bilateral THA Group Allocation: PCEA Group (Intervention): Received patient-controlled epidural	Secondary Outcomes: Patient satisfaction, quality of recovery, opioid related side effects, total opioid consumption, length of stay, pain scores at rest and also with ambulation/during physical therapy	Opioid Consumption: The PAI group was found to require more opioids Functional Recovery: There was no difference found in terms of readiness for discharge/length of stay. The PAI group averaged 2.4 days vs. PCEA group which averaged 2.3 days. P = .086 thus this was a significant finding. Side Effects: The PCEA group was found to have alot more side effects including N/V, pruritus, dizziness, and headache Patient Satisfaction: There was no significant difference between the groups in this aspect Conclusion: PCEA was more efficacious for analgesia during movement and also necessitated	PCEA (epidural PCA) differs from IV PCA or oral PCA routes used in other studies which limits generalization to other PCA modalities. Confounder amongst control group: The control notably received methylprednisolone which is known to decrease nausea and inflammation. This can alter pain assessment and side effects in the control group. Short-term Follow-up: Outcomes focused on early postoperative period (first 48 hours). No long-term functional or satisfaction outcomes beyond discharge readiness. Potential Performance Bias: Although double-blind, differences between epidural infusion vs PAI/MMPR could create subtle unblinding (catheter presence,

		analgesia with 0.06% bupivacaine + hydromorphone, epidural pump actual medication PAI/MMPR Group (Comparison): Received peri-articular analgesic injection with 0.5% bupivacaine + epinephrine, morphine, methylprednisolone, cefazolin in addition to a multimodal pain regimen (acetaminophen, ketorolac & later meloxicam, PRN oxycodone), with a placebo epidural infusion of normal saline		less opioid use amongst its users. PAI had fewer opioid-related side effects but was noted to have worse pain control and more opioid use.	side effect profiles). <u>Sample Size:</u> Moderate sample size (n=90), may be insufficient to detect rare complications.

<u>Conclusion(s):</u>

Across the five studies, evidence shows that patient-controlled analgesia (PCA) generally provides pain relief comparable to traditional PRN analgesia, though the degree of benefit varies by study design and comparator. PCA often results in **higher patient satisfaction** and, in some cases, **more stable or efficient opioid use**, but not consistently lower pain scores. Some studies demonstrated **no significant difference** in opioid consumption or pain intensity between PCA and PRN methods, while others showed improved early analgesia with PCA—particularly epidural PCA. Side effects were overall similar across groups, though some PCA methods carried higher risks (e.g., hypotension with epidural PCA). Across the literature, variability in populations, surgical types, PCA modalities, comparison groups, and outcome measures limits the strength and consistency of conclusions.

Clinical Bottom Line:

Please include an assessment of the worth to practice

PCA is an effective option for post-operative pain management in patients who have undergone joint-replacement, including total hip arthroplasty. PCA has shown higher patient satisfaction and an ability for individualized dosing. However, it does not consistently outperform PRN IM or other non-PCA analgesia in regards to pain control. Clinicians should individualize pain control regimens based on the needs and priorities of the patient, All in all, PCA is a practice that should be considered and offer the greatest benefits for patients who prefer greater control over their own pain management.