



Mini-CAT

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Clinical Scenario

Your orthopedist supervising physician has asked you to help out with the research on a presentation she is to give next week on patient controlled anesthesia (PCA) in adult post-op total hip replacement patients. She needs to know how effective PCA is compared to PRN (as needed) pain medication.

Clinical Question

In adults post-total hip replacement, what is the efficacy of patient controlled anesthesia (PCA) compared to PRN pain medication in post-op pain management?



PICO Search Terms

Patient / Problem	Intervention	Comparison	Outcome
Adults post-op total hip replacement	Patient controlled anesthesia	PRN Pain Medication	Effective Pain Management
Adults after total hip arthroplasty	Patient controlled analgesia	PRN Analgesia	Pain control
		Standard Pain Management	Patient satisfaction
		As needed pain medication	Adverse Effects

Search Strategy Summary

Databases Searched:

- **CUNY OneSearch**
 - Search criteria → 107 results + filters → 57 results
 - 2 studies selected from results, and another 1 found via “Similar Articles”
- **PubMed**
 - Search criteria → 25 studies + filters → 11 results
 - 1 study selected
- **ScienceDirect**
 - Search criteria → 188 studies + filters → 84 results
 - 1 study selected

Studies Prioritized Based On:

- **Drug Routes Compared**
 - We prioritized studies comparing PCA and PRN drugs **given the same route**, to control the possibility of that confounding variable
- **Post-op status**
 - We prioritized studies of patients **post-total hip arthroplasty** rather than other surgical procedures
- **Level of evidence/recency**
 - We prioritized **higher-level study types** from **as recently as possible**

Appraised Articles

1. [Patient-controlled epidural analgesia versus conventional epidural analgesia after total hip replacement – a randomized trial](#)
 - a. (Maca et al., 2020)
2. [A Prospective Randomized Trial of an Oral Patient-Controlled Analgesia Device Versus Usual Care Following Total Hip Arthroplasty](#)
 - a. (Pizzi et al., 2020)
3. [Minimizing Opioid Use After Total Hip Arthroplasty: Comparing Periarticular Injection Versus Patient-Controlled Epidural Analgesia Versus a Combination Protocol.](#)
 - a. (Jules-Elysee K, et al., 2020)
4. [Comparison of Patient-Controlled versus Continuous Epidural Analgesia in Adult Surgical Patients: A Systematic Review](#)
 - a. (van Samkar, et al., 2023)
5. [Comparison between patient-controlled analgesia and subcutaneous morphine in elderly patients after total hip replacement](#)
 - a. (Keita, et al., 2017)

Patient-controlled epidural analgesia versus conventional epidural analgesia after total hip replacement – a randomized trial

Criteria: Adults post-total hip replacement in the ICU at a tertiary university hospital

- **Inclusion criteria**
 - Age > 18 years, Informed consent for participation, ASA I–III on pre-anesthesia evaluation,
 - GCS 13 or more, Modified Bromage Score 0 or 1, Visual Analog Score (Pain) ≥ 4
 - Spontaneous breathing at a rate of 12–24 breaths/min, SpO₂ $\geq 90\%$
- **Exclusion criteria**
 - A history of long-term opioid therapy 0–4 days before surgery
 - Indications for revision surgery during immediate postoperative care
 - Acute skin disease

Methods and Procedures:

- **Per-protocol randomization** into groups using the envelope method performed by an unaffiliated physician, giving each participant a 50% chance of being assigned to either study or control.
 - **PCEA group (n=55)** was given initial analgesic bolus + infusion with additional PC bolus with lockout interval of 20 min, and a maximum dose of 40 mL/4h (according to literature recommendation).
 - **Non-PCEA group (n=56)** was given initial analgesic bolus + infusion. If pain developed, additional bolus was administered (according to the physician's prescription).
- **Vitals, pain scores, degree of motor block, and post-operative nausea/vomiting** were assessed every hour for 24 hours. Pain was assessed 30m after administration of additional analgesic.
- **Overall Satisfaction and total use of analgesics** were assessed after ICU discharge.

Patient-controlled epidural analgesia versus conventional epidural analgesia after total hip replacement – a randomized trial

Results

- The **PCEA group** had:
 - Significantly **lower total consumption of analgesic mixtures** (0.9 ± 0.3 and 1.3 ± 0.4 mL/kg per day, $P < 0.001$)
 - Significantly **greater patient satisfaction** ($P < 0.001$)
- There was *no significant difference between groups* in:
 - The mean pain intensity over 24 hours postoperatively ($P = 0.14$)
 - The rate of analgesia-related adverse complications (hypotension, $P = 0.14$; bradypnea, $P = 0.11$)

Limitations

- Overseas study → Cultural perceptions and participant race were not acknowledged, different pain management regimens than American standard
- **Relatively small sample** with some differences in baseline characteristics of groups (age, gender)
- **Neither subjects nor staff were blinded**
- If **analgesia was insufficient after one hour of maximal dosing** in both groups, the patient was given adjunctive analgesic therapy and **was excluded from final analysis**
 - PCEA group $n = 6$, non-PCEA group $n = 2$

Oral Patient-Controlled Analgesia Device Versus Usual Care Following Total Hip Arthroplasty: A Prospective Randomized Control Trial

Criteria:

- Adults 18 years+
- Patients that underwent elective primary total hip arthroplasty with **no evidence of receiving opioids for the past week** or longer

Methods:

- 60 patients were randomized into 2 groups with the use of a randomization program done by the study's statistician:
 - **Group 1:** Patient-controlled analgesia with a **device used to administer oxycodone 5mg** with a lockout of 2 hours PRN.
 - **Group 2:** Usual care received, with oxycodone 5mg administered PO for mild to moderate pain (pain score 4-6) every 4 hours **as needed**. For severe pain (pain score 7-10), oxycodone 10mg by mouth every 4 hours as needed.
- **Patient length of hospital stay, pain intensity scores, and total opioid consumption** were obtained via electronic chart review.
- Patient Survey administered on the day of discharge to answer questions on **pain levels** during the 24 hours prior to discharge and how the **pain interfered with performance** that might impact recovery.

Procedures:

- Patients in group 1 were **educated on how to use the device** and on the **numeric scale to rate pain** from 0 to 10 (with 0 no pain).
- Pain assessment, which included patient's numeric pain score, quality descriptors of the pain, sedation level, and other observations regarding pain or needs were **assessed every 4 hours by the nurse**.

Oral Patient-Controlled Analgesia Device Versus Usual Care Following Total Hip Arthroplasty: A Prospective Randomized Control Trial

Results:

- The Control group reported **significantly higher pain scores** (6.0; $p < .0001$) while taking **higher average doses of oxycodone** of 8.2mg compared to the device group with a mean pain score of 4.7 ($p < .0001$) with an average of 5.1mg oxycodone use per dose.
- Patient surveys obtained on the day of discharge indicated that 70% of the device group reported a pain at its worst as 5 or greater whereas 83% of the control group reported their worst pain as 5 or greater during the 24 hours prior to discharge.

Limitations:

- Research staff was not blinded
- Small sample size
- Long term effects were not assessed
- There were no statistical significance to detect differences in some secondary outcomes such as pain prior to discharge and pain score at rest and activity

Minimizing Opioid Use After Total Hip Arthroplasty: Comparing Periarticular Injection Versus Patient-Controlled Epidural Analgesia Versus a Combination Protocol

Criteria:

- Patients were randomly assigned to one of three treatment groups.
- Specific inclusion: The study includes patients with osteoarthritis scheduled for primary total hip arthroplasty, aged 45 to 80. Eligible participants should be planned for regional anesthesia and a posterolateral surgical approach and have the ability to follow the study's protocol.
- Exclusion criteria: Excluded individuals are those outside the 45-80 age range, planning general anesthesia, with ASA IV classification, insulin-dependent diabetes, hepatic or renal failure, chronic opioid use over three months, or a history of major hip surgery on the same side.

Methods:

- Double-blinded randomized controlled trial.
- Three treatment groups were compared: PCEA, PAI, and PCEA + PAI.
- 3 different protocols: (1) Local anesthetic administered patient-controlled epidural analgesia (PCEA) without intrathecal opioids; (2) Periarticular injection (PAI); and (3) PCEA + PAI.
- All patients received the same postoperative multimodal analgesic regimen.
- Primary outcome: Opioid consumption, measured at 24, 48, and 72 hours.
- Secondary measures included pain scores, patient satisfaction, and quality of recovery

Minimizing Opioid Use After Total Hip Arthroplasty: Comparing Periarticular Injection Versus Patient-Controlled Epidural Analgesia Versus a Combination Protocol

Procedures:

- Patients received their assigned treatment.
- Data collected for opioid consumption and secondary outcomes.
- Monitoring for opioid-related side effects.
- Data were analyzed statistically.

Results:

- PAI + PCEA group had significantly lower opioid consumption in the first 24 hours compared to PAI alone. (30 versus 15, P = .012)
- More patients in the PAI + PCEA group were opioid-free during the first 24 hours.(23.7 versus 8.5%, P = .043)
- No significant differences among groups for secondary outcomes for length of stay, pain scores, patient satisfaction, or duration of surgery.

Limitations:

- Findings may not be generalizable to other patient populations.
- The study was conducted at a single center.
- Sample size of 180 may limit statistical power.
- Longer-term effects were not assessed.

Comparison of Patient-Controlled versus Continuous Epidural Analgesia in Adult Surgical Patients: A Systematic Review

Criteria:

- Data was collected from Embase, PubMed, and Cochrane Library
- RCTs and cohort studies* which included adult surgical patients 18 years+ receiving perioperative epidural analgesia
- Studies which compared patient-controlled epidural analgesia vs conventional epidural analgesia

Methods:

- 6 RCTs comprising of 480 patients were included in the systematic review
- Meta analysis was performed using Cochrane's Review Manager 5.4 software (4+ RCT)
 - **Primary outcome** looked at was postoperative day 1 pain scores.
 - **Secondary outcomes** were the total amount of analgesic use 24 or 48 hours post op, the use of additional systemic analgesics, manual top-ups, side effects, and patient satisfaction.

Comparison of Patient-Controlled versus Continuous Epidural Analgesia in Adult Surgical Patients: A Systematic Review

Results:

- Primary result
 - Pain scores were reduced by 36-44% among the patients that used PCEA compared to CEA on POD1
- Secondary result
 - 4 of the studies included determined a decrease in epidural drug use of 28-40% amongst patients using PCEA compared to CEA
 - A study found a 23% reduction in top ups amongst patients using PCEA
 - 2 studies found higher patient satisfaction with PCEA compared to CEA

Limitations:

- The studies included were heterogeneous
 - patient population
 - Surgical procedure
 - Medication used
- Number of studies included were limited
- Results were not conclusive

Comparison between patient-controlled analgesia and subcutaneous morphine in elderly patients after total hip replacement - Randomized Trial

Criteria:

- Adults 70 years and older.
- Patients that were scheduled to have elective primary total hip reconstruction, a preoperative mini mental score ≥ 26 , and no contraindications to PCA use.

Methods/Procedure:

- 40 patients were randomly assigned into 2 groups using a random number table.
 - **Group 1:** Patient-controlled analgesia (1 m.g of morphine i.v.) administered via pump with a lockout of 8 minutes.
 - **Group 2:** Subcutaneous injections of morphine administered 4 hours after the study began. The injections could be repeated every 4 hours if the patients reported continued pain (Vision Analogue Scale ≥ 30).
- **Postoperative pain** was assessed at rest and when moving every 4 hours using the Vision Analogue Scale (VAS).
 - All patients were given instruction on how to use the Visual Analogue Scale for pain.
- **Cognitive function** was assessed using a mini mental status exam prior to surgery and 2,24, and 48 hours after surgery.
- **Side effects** were recorded for the first 48 hours post surgery.

Comparison between patient-controlled analgesia and subcutaneous morphine in elderly patients after total hip replacement - Randomized Trial

Results:

- The group that received the **patient controlled anesthesia (PCA)** reported **significantly less pain** than the group that received the scheduled subcutaneous morphine injections both at rest and during movement.
- There were **no significant differences in mini mental status scores, length of hospital stay, amount of morphine used, or incidence of side effects** between the two groups

Limitations:

- Small sample size (40 patients)
- Limited to only elderly patients (70 years old and above)
- Study done overseas (performed in France)
- True double blinding was not possible as patients were able to differentiate genuine PCA infusions and placebo infusions.

Summary of Mini-CAT Grid

Key Findings:

- **Maca et al., 2020**
 - PCA group had significantly:
 - ↓ total consumption of analgesic mixtures
 - ↑ patient satisfaction
 - The mean pain intensity and rate of analgesia-related complications were similar between both groups.
- **Pizzi et al., 2020**
 - Device Group (PCA) had significantly:
 - ↓ overall pain scores
 - ↓ dosage of Oxycodone use
 - The mean pain intensity scores prior to activity and one day prior to discharge were not statistically significant.
- **Jules-Elysee K, et al., 2020**
 - When compare to PAI or PCEA alone:
 - PAI + PCEA group had significantly lower opioid consumption in the first 24 hours
 - PAI + PCEA group were opioid-free during the first 24 hours
- **Van Samkar, et al., 2023**
 - When compared to CEA, PCEA showed:
 - ~ pain scores
 - ↓ use of systemic analgesia
 - ↑ patient satisfaction
- **Keita, et al., 2017**
 - PCA had lower pain scores (VAS)
 - Similar cognitive scores, amount of analgesic used, length of hospital stay and side effects between both groups

Clinical Bottom Line:

In adults post-op total hip replacement, what is the efficacy of patient controlled anesthesia (PCA) compared to PRN pain medication for pain management?

In adults recovering from total hip arthroplasty, compared to as-needed analgesia,

PCA is consistently effective in:

- Achieving **higher levels of patient satisfaction**
- **Lowering total consumption** of analgesic drugs

PCA results in at least similar, and possibly better:

- Control of pain intensity
- Rates of analgesia-associated adverse effects

Thus, PCA has ***unique systemic and psychological benefits worth considering in the pain management plans of patients*** recovering from total hip-arthroplasty.

However...

- PCA is a relatively new modality, and there is **limited research in its efficacy in American populations**
- Most **samples researched were small**
- Given required procedures, it is **difficult to blind participants and staff** in studies on PCA
- **Cost was not taken into consideration** when implementing PCA
- The time and resources needed to educate patients on the use of PCA and its feasibility were not assessed as opposed to pain medication administered as needed

Further studies should:

- Focus on American populations using standard American pain management regimens
- Expand across multiple clinical settings and recruit larger samples
- Follow up longitudinally, perhaps to assess rate of analgesia-associated effects

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