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 Question:
P → Adults post-total hip replacement
I → Patient controlled analgesia
C → PRN pain medication
O → Effective post-op pain management

Search Strategy:

Databases	Terms Used	Articles Returned	Limits Added	Articles Returned
York OneSearch	Patient-Controlled Anesthesia OR Patient-Controlled Analgesia AND PRN OR as needed AND pain control OR pain management OR analgesia AND total hip replacement OR hip arthroplasty AND post-op NOT knee arthroplasty NOT knee	107	Last 5 Years Age 19+	57

	replacement			
PubMed	Patient controlled analgesia versus care in total hip arthroplasty	25	Last 5 years Age 19+	11
Science Direct	Patient controlled anesthesia and PRN anesthesia total hip replacement	188	Last 10 years	84

- How you selected the final articles to base your CAT on
    - Drug Routes
        - 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

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

- Patient-controlled epidural analgesia versus conventional epidural analgesia after total hip replacement – a randomized trial
    - **Background:** Patient-controlled analgesia (PCA) is usually considered a better option for pain management compared to conventional analgesia. The beneficial effect of PCA has been assessed in a number of studies; however, the results are inconsistent. The goal of this study was to compare patient-controlled epidural analgesia (PCEA) to conventional epidural analgesia after total hip replacement (THR).
    - **Methods:** This prospective study was performed at the Department of Anesthesia and Intensive Care Medicine at a tertiary university hospital. After THR, patients were admitted to the intensive care unit (ICU) and randomized to one of two groups (PCEA and non-PCEA). Postoperative pain in the PCEA group was treated using a standardized protocol,

while the analgesia in the non-PCEA group was based on physician prescription according to the patient's clinical condition. The total consumption of analgesics, patients' satisfaction, pain intensity, and analgesia-related complications were recorded for 24 h after surgery.

- **Results**: The final sample consisted of 111 patients (PCEA group, n=55 and non-PCEA group, n=56). 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).There was greater patient satisfaction (P<0.001) in the PCEA group. The mean pain intensity over 24 hours postoperatively was similar for both groups (P=0.14). There was no significant difference in rate of analgesia-related complications between the groups (hypotension, P=0.14; bradypnea, P=0.11).
- **Conclusion:** Compared to conventional epidural analgesia based on physician prescription, PCEA led to less total analgesic consumption and greater patient satisfaction after THR.]

- A Prospective Randomized Trial of an Oral Patient-Controlled Analgesia Device Versus Usual Care Following Total Hip Arthroplasty
  - **Background**: Multimodal pain management for surgery patients may include the use of a combination of scheduled oral pain medications with as-needed (PRN) oral opioids. Multiple concurrent time demands on nursing staff frequently cause delays in the delivery of oral PRN pain medication compromising pain management.
  - **Purpose:** Postoperative pain control was compared using a wireless oral patient-controlled analgesia device for the delivery of oxycodone with a control group receiving PRN oxycodone from nursing staff.
  - **Methods:** Thirty patients were prospectively randomized into each of 2 groups after total hip arthroplasty. Patient demographics, pain scores, drug dose data, and physical therapy data were collected from chart reviews. Additional data were obtained from patient and nursing surveys.
  - **Results:** Device patients recorded statistically lower pain scores while taking lower doses of oxycodone on postoperative Day 1 as compared with the control group. Patient surveys indicated that those in the device group reported lower pain scores 24 hours prior to discharge, albeit not statistically different from the control group. Men in the device group reported statistically lower pain scores with physical therapy than men in the control group. Findings from the nursing survey indicate that nurses favored the device over nurse-administered PRN.
  - **Conclusion:** Patients using the wireless patient-controlled analgesia (PCA) (oral) device had less pain at rest and with activity (men) while taking lower doses of oxycodone with each dose. Nursing surveys indicated that nursing staff in

this orthopedic postoperative unit found the device easy to use, reliable, and efficient. They also recommended its adoption for those capable of using it.

- Minimizing Opioid Use After Total Hip Arthroplasty: Comparing Periarticular Injection Versus Patient-Controlled Epidural Analgesia Versus a Combination Protocol
    - **Background:** Effective management of postoperative pain after total hip arthroplasty (THA) may be challenging. We sought to develop an opioid-sparing pain management pathway by comparing the relative effectiveness of 3 different protocols: (1) Local anesthetic administered patient-controlled epidural analgesia (PCEA) without intrathecal opioids; (2) Periarticular injection (PAI); and (3) PCEA + PAI.
    - **Methods:** In this double-blinded randomized controlled trial, 180 patients undergoing THA were randomized to receive either (1) PCEA with 0.06% bupivacaine, (2) PAI, or (3) a PAI + PCEA with 0.06% bupivacaine. All patients received the same postoperative multimodal analgesic regimen. The primary outcome was opioid consumption, measured in oral morphine equivalents, at 24, 48, and 72 hours after anesthesia stop time. Secondary measures included pain at rest and with movement, opioid side effects, patient satisfaction, and quality of recovery, as assessed via standardized self-reporting scales and surveys.
    - **Results:** Opioid consumption was significantly higher in the PAI group in the first 24 hours postoperatively compared to the PAI + PCEA group (30 versus 15, P = .012). No differences were detected among groups for length of stay, pain scores, patient satisfaction, or duration of surgery. More patients in the PAI + PCEA group were opiate-free in the first 24 hours compared to PAI (23.7 versus 8.5%, P = .043).
    - **Conclusion:** Use of PAI + PCEA regimen was opioid-sparing in the first 24 hours after surgery, favoring this group when opioid reduction is desired. Increased drowsiness was noted in the subsequent 24 to 48 hours once the epidural catheter was removed and opioid consumption also increased.
- Comparison of Patient-Controlled versus Continuous Epidural Analgesia in Adult Surgical Patients: A Systematic Review
    - **Background:** The advantages of PCEA over CEA have been demonstrated in obstetric patients. Whether a similar benefit applies to surgical patients is unclear.
    - **Methods:** Embase, PubMed, and Cochrane Library were searched, enabling a systematic review of studies comparing PCEA and CEA in adult surgical patients (PROSPERO: CRD42018106644). The study quality was assessed using the Cochrane risk-of-bias tool (RoB2). The primary outcome was pain scores on postoperative day one (POD1). Secondary

outcomes were 24 or 48 h epidural or intravenous total analgesic dose, systemic analgesics, manual top-ups, side effects, and patient satisfaction.

- **Results:** Six randomized controlled trials with high heterogeneity of study characteristics were identified with a moderate risk of bias. Two studies showed significantly reduced resting pain scores on POD1 in PCEA compared with CEA patients (36-44%, $p < 0.05$). Four studies found comparable pain scores between these groups. PCEA use reduced epidural medication (28% to 40% reduction, $p < 0.01$) in four studies. One study found a 23% reduction ($p < 0.001$) of top-ups in PCEA; intravenous morphine use by PCEA patients was reduced (0.16 vs. 3.45 mg per patient, $p < 0.05$) in one study. PCEA patients were more satisfied with analgesia ($p < 0.001$) in two studies. Nausea and vomiting were reduced in PCEA ($p = 0.01$).
- **Conclusions:** Regarding the reduction in pain scores, the effects of PCEA were not significant or clinically not relevant. However, regarding the amount of epidural drug use, the amount of required rescue systemic analgesics, patient satisfaction, and the number of required top-ups, PCEA had advantages over CEA in surgical patients.

- Comparison between patient-controlled analgesia and subcutaneous morphine in elderly patients after total hip replacement
  - **Background:** The goal of this study was to evaluate the effectiveness on postoperative pain, and cognitive impact, of patient-controlled analgesia (PCA) compared with subcutaneous (s.c.) injections of morphine in elderly patients undergoing total hip replacement (THR).
  - **Methods:** Forty patients older than 70 yrs were randomly assigned to two different postoperative analgesic techniques for 48 h: i.v. PCA morphine (dose, 1 mg; lockout interval, 8 min; PCA group) or regular s.c. morphine injections (SC group). Postoperative pain was assessed at rest and when moving, using a visual analogue scale (VAS) every 4 h. A Mini Mental Status (MMS) examination was used to assess cognitive functions before surgery, at 2 h, 24 h and 48 h after surgery, and at hospital discharge. Side-effects were also recorded systematically during the first 48 h after surgery
  - **Results:** The PCA group showed significantly lower pain scores than the SC group both at rest and during mobilization. However, the clinical significance of pain scores was weak. There was no intergroup difference in postoperative MMS scores. The incidence of side-effects was similar in both groups.

- **Conclusions**: We conclude that in healthy elderly subjects undergoing THR, the flexibility of the analgesic regimen is more important than the route of administration with regard to efficacy, adverse effects and recovery of cognitive function.

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**
Maca et al, 2020.	Level 2 - RCT	111 adults post-total hip replacement (PCEA group, n=55 non-PCEA group, n=56) in ICU at a tertiary university hospital	In the 24h post-op: 1. Consumption of analgesics 2. Pt satisfaction 3. Pain intensity 4. Analgesia-related complications	PCEA group had: significantly: • ↓ total consumption of analgesic mixtures • ↑ patient satisfaction – The mean pain intensity and rate of analgesia-related complications were similar for both groups.	• Overseas study → Race, culture, were not acknowledged, American drug regimens were not used • Relatively small sample with some differences in baseline characteristics of groups (age, gender) • Neither subjects nor staff were blinded • Patients who needed adjunctive analgesic were excluded from final analysis
Pizzi et al, 2020.	Level 2 - RCT	This is a randomized controlled trial with 60 patients older than 18 that underwent total hip arthroplasty that	- Numeric pain score from patient from 0 being no pain and 10 being high pain.	- Control groups had significantly higher pain scores compared to patient controlled analgesia.	- The research staff was not blinded. - The small sample size may limit the statistical significance of the findings.

		were divided into 2 groups. Group 1 consisted of those that received a device to request oxycodone vs group 2, which was the care control group and received oxycodone PRN.	- Total oral opioid consumption. - Duration of hospital stay.	- Less pain was perceived by the device group as compared to the control group 24 hours prior to discharge.	- The statistical power was insufficient to detect differences in some secondary outcomes such as pain prior to discharge, pain score at rest and activity, and pain score at rest. - Long term effects were not assessed.
Jules-Elyse e K, et al,2020	Level 2 RCT	180 patients undergoing total hip arthroplasty. Eligible participants aged 45 to 80. Three treatment groups were compared: PCEA, PAI, and PCEA + PAI. (1) Local anesthetic administered patient-controlled epidural analgesia (PCEA) without intrathecal opioids; (2) Periarticular	**Primary outcome**: Opioid consumption, measured at 24, 48, and 72 hours. **Secondary outcome** measures included pain scores, patient satisfaction, and quality of recovery. Goals: maximize pain control while minimizing opioid use and side effects.	**PAI + PCEA** group had significantly lower opioid consumption in the first 24 hours compared to PAI alone. More patients in the **PAI + PCEA** group were opioid-free during the first 24 hours. No significant differences among groups for secondary outcomes.	Findings may not be generalizable to other patient populations outside 45-80. The study was conducted at a single center. Sample size of 180 may limit statistical power. Longer-term effects were not assessed.

		injection (PAI); and (3) PCEA + PAI.			
Van Samkar et al. (2023)	Level 1 – Systematic Review	A systematic review was conducted to compare the efficacy of patient controlled analgesia (PCEA) compared to continuous epidural analgesia (CEA). Data was collected from Embase, PubMed, and Cochrane Library. The study quality was assessed using the Cochrane risk-of-bias tool (RoB2).	The **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, systemic analgesics, manual top-ups, side effects, and patient satisfaction.	6 RCTs were identified. - 2 studies showed ↓ resting pain scores on POD1 in **PCEA** compared with CEA patients. - 4 studies found comparable pain scores between these groups. - PCEA use ↓ epidural medication in 4 studies. - IV morphine use by PCEA patients was ↓ in one study. - PCEA patients were more satisfied with analgesia in two studies. - Nausea and vomiting were reduced in PCEA.	- heterogeneity in the studies used, patient population, publication date of studies included, type of surgery, epidural site and medication used - # of studies and patients included was limited - The specific PCEA regimen employed was heterogeneous, with the common factor being “local anesthetic in the epidural medication”.
Keita, et al., (2017)	Level 2 – RCT	This is a randomized controlled trial of 40 post operative total hip procedure patients that were at least 70 years	The outcomes studied were: - **Evaluation of pain** at rest and movement using the Visual	-The group that received the patient controlled anesthesia (PCA) reported significantly less pain then the group receiving subcutaneous morphine injections.	-Limitations include that there were only 40 individuals studied, the more subjects the better the validity of the study. - The study was limited to patients who are 70 and above. There may

		old. The patients were split amongst two groups differing in analgesic techniques. The first group was anesthetized using PCA (patient controlled anesthesia) morphine while the other group was anesthetized using regular subcutaneous morphine injections.	Analogue Scale every 4 hours. - **Cognitive Impact** of both types of anesthesia using a mini mental status (MMS) prior to the surgery, 2,24, and 48 hours after surgery and at discharge. -Side effects were also recorded.	-There was no significant difference in mini mental status exam results, amount of morphine used, or side effects noted.	be different results in other age populations. - Study was performed overseas in France - True double blinding was unable to be achieved as patients were able to tell the difference between genuine PCA infusions and placebo.

Conclusion(s):

Maca J, Neiser J, Grasslova L, Trlicova M, Streitova D, Zoubkova R. Patient-controlled epidural analgesia versus conventional epidural analgesia after total hip replacement - a randomized trial. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2020 Mar;164(1):108-114. doi: 10.5507/bp.2018.068. Epub 2018 Nov 6. PMID: 30398221.

The PCEA modality of delivery is associated with less total analgesic consumption, more satisfaction, and similar efficacy of pain management with similar rates of adverse analgesia-related complications compared to the conventional mode of epidural analgesia after total hip replacement.

Pizzi LJ, Bates M, Chelly JE, Goodrich CJ. A Prospective Randomized Trial of an Oral Patient-Controlled Analgesia Device Versus Usual Care Following Total Hip Arthroplasty. Orthop Nurs. 2020;39(1):37-46. doi: 10.1097/NOR.0000000000000624
The use of a patient controlled analgesia (PCA) results in better pain management and the delivery of lower doses of pain medication overall. Additionally, nursing staff expressed strong favorability toward the PCA devices, stating the ease of use and a preference for future use.

Jules-Elysee K, Freeman C, Maalouf D, YaDeau J, Mayman D, Sculco P. Minimizing Opioid Use After Total Hip Arthroplasty: Comparing Periarticular Injection Versus Patient-Controlled Epidural Analgesia Versus a Combination Protocol. J Arthroplasty. 2023;38(1):101-107. doi:10.1016/j.arth.2022.06.025
PAI + PCEA group had significantly lower opioid consumption in the first 24 hours compared to PAI alone. More patients in the PAI + PCEA group were opioid-free during the first 24 hours. PCEA have added Local anesthetic administered patient-controlled epidural analgesia (PCEA) Periarticular injection (PAI)

Van Samkar G, Ru Tan Y, Hermanns H, et al. Comparison of Patient-Controlled versus Continuous Epidural Analgesia in Adult Surgical Patients: A Systematic Review. *Journal of Clinical Medicine*. 2023;12(9):3164. doi:https://doi.org/10.3390/jcm12093164
The effects of PCEA did not significantly reduce pain scores when compared to CEA. PCEA decreased the amount of epidural drug use, rescue systemic analgesics, and the number of required top-ups compared to CEA. Patient satisfaction was increased with use of PCEA.

Keïta H, Geachan N, Dahmani S, et al. Comparison between patient-controlled analgesia and subcutaneous morphine in elderly patients after total hip replacement . British Journal of Anaesthesia. 2003;90(1):53-57. doi:https://doi.org/10.1093/bja/aeg019

The use of patient controlled anesthesia resulted in reduced pain scores when compared to scheduled subcutaneous injection anesthesia but the difference in scores were not significant. The study showed that the flexibility of administration of analgesic medication plays a factor in efficacy.

Clinical Bottom Line:

Compared to as-needed analgesia, PCA is consistently effective in achieving higher levels of patient satisfaction and lowering total consumption of analgesic drugs in adults recovering from total hip arthroplasty. These systemic and psychological benefits were achieved with a similar, if not better, control of pain intensity and rate of analgesia-associated adverse effects compared with PRN pain medications. Thus, PCA's unique benefits and comparable efficacy are worth considering in the pain management plans of patients recovering from total hip arthroplasty.