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Multimodal Pain Management in Older Elective Arthroplasty Patients

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Abstract

Background: Pain management after elective arthroplasty in older adults is complicated due to the risk of undertreatment of postoperative pain and potential adverse effects from analgesics, notably opioids. Using combinations of analgesics has been proposed as potentially beneficial to achieve pain control with lower opioid doses. **Objective:** We compared a multimodal pain protocol with a traditional one, in older elective arthroplasty patients, measuring self-rated pain, incidence of postoperative delirium, quantity and cost of opioid analgesics consumed. **Methods:** One hundred fifty-eight patients, 70 years and older, admitted to tertiary care for elective arthroplasty were prospectively assessed postoperative days 1–3. Patients received either traditional postoperative analgesia (acetaminophen plus opioids) or a multimodal pain protocol (acetaminophen, opioids, gabapentin, celecoxib), depending on surgeon preference. Self-rated pain, postoperative delirium, and time to achieve standby-assist ambulation were compared, as were total opioid doses and analgesic costs. **Results:** Despite receiving significantly more opioid analgesics (traditional: 166.4 mg morphine-equivalents; multimodal: 442 mg morphine equivalents; $t = 10.64$, $P < .0001$), there was no difference in self-rated pain, delirium, or mobility on postoperative days 1–3. Costs were significantly higher in the multimodal group ($t = 9.15$, $P < .0001$). Knee arthroplasty was associated with higher pain scores than hip arthroplasty, with no significant difference in opioid usage. **Conclusion:** A multimodal approach to pain control demonstrated no benefit over traditional postoperative analgesia in elective arthroplasty patients, but with significantly higher amounts of opioid consumed. This poses a potential risk regarding tolerability in frail older adults and results in increased drug costs.

Keywords

multimodal pain management, elderly, arthroplasty, drug costs, delirium

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Introduction

Delirium is a common postoperative complication among older patients undergoing total joint arthroplasty, estimated to occur in 7% to 15% who have an elective surgery and up to 65% in hip fracture patients.[1-4] Outcomes associated with delirium are poor and include longer hospital stays, institutional placement, cognitive and functional decline, and increased risk of mortality.[5-8] Numerous risk factors for delirium have been identified, including both poorly managed postoperative pain and the use of opioid analgesia.[9,10] Pain management presents a particular challenge in the older population as they may be more sensitive to the effects of the medications, especially related to central nervous system effects. Accordingly, safe and effective pain control is an important preventative measure.

Multimodal approaches to postoperative pain management have been advocated as potentially having an opioid-sparing effect, while still achieving adequate postoperative pain

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control, given the use of multiple analgesics in combination to act on distinct sites along the nociceptive pathway.[11-13] However, there are conflicting reports regarding the safety and efficacy of multimodal approaches.[11,14,15] It is also not clear what the contribution of using multiple pain medications in the perioperative setting is to polypharmacy in older individuals. It may be that using multiple medications actually contributes to polypharmacy and adverse events, such as delirium, in older adults.

At our center, 7 of 9 orthopedic surgeons adopted a multimodal regimen for pain management, using a combination of analgesics. This provided an opportunity to compare a multimodal pain management approach with a more traditional one in elective arthroplasty patients. The objective of this study was to compare outcomes in elective arthroplasty patients 70 years and older with respect to (1) postoperative delirium, (2) self-rated pain, (3) amount of opioid consumed, and (4) total cost of analgesics.

Table 1. Baseline Characteristics of Groups.

	Traditional Pain Management (n = 54)	Multimodal Pain Management (n = 104)	*P*
Age (SD)	76.2 (5.2)	76.6 (4.7)	$t = 0.39$, $P = .70$
Baseline MMSE/30 (SD)	27.9 (3)	28.0 (2)	$t = 0.19$, $P = .85$
Male (%)	32 (59%)	53 (%)	$\chi^2 = 0.98$, $P = .16$
Surgery (%)			$\chi^2 = 6.17$, $P = .013$
Knee (n = 99)	41 (75.9%)	58 (55.8%)	
Hip (n = 59)	13 (24.1%)	46 (44.2%)	

Abbreviation: MMSE, Mini-Mental State Examination.

Methods

Setting

This study takes place at a tertiary care hospital that performs approximately 460 elective total hip replacements and 550 total knee replacements per year.

Study Design

This was a prospective, nonrandomized, observational review comparing current pain management practices in elective, hip and knee arthroplasty patients. The study was approved by the Capital Health Research Ethics Board (CDHA-RS 2010-257).

Participants

Inclusion criteria for the study were age 70 years and older, ability to speak and understand English, and hospital admission for elective hip or knee arthroplasty surgery. Patients were excluded if it was a revision surgery. One hundred fifty-eight patients were approached and consented; no one refused to participate. It was explained that their pain management regimen was based on their surgeon's preference, that the study would not influence the care they would receive, and that they could withdraw at any time.

Medication Protocols

The traditional pain regimen consisted of regularly dosed acetaminophen 650 to 975 mg every 6 hours and an opioid available every 3 to 4 hours on an as-needed basis (hydromorphone orally 2 to 4 mg or morphine orally 15 to 30 mg). The multimodal protocol included subcutaneous hydromorphone 1 to 2 mg every 3 hours as needed until 0800 hours of postoperative day 1, when it was switched to oxycodone controlled release (CR) 5 to 10 mg every 8 hours for 9 doses and oxycodone immediate release 5 to 10 mg every 4 hours on an as-needed basis. In addition, patients received celecoxib 100 to 200 mg every 12 hours, gabapentin 100 to 200 mg every 8 hours, and acetaminophen 650 to 975 mg every 6 hours.

Procedures

All patients were seen in the preoperative area the morning of surgery. After consenting to participate, participants were assessed using the Mini-Mental State Examination (MMSE), Confusion Assessment Method (CAM), and pain self-rating scale. Each participant was assessed on postoperative day 1, 2, and 3 using the same tools. Daily medication records and physiotherapy notes were reviewed for postoperative days 1 through 3. All assessments were performed by 1 investigator (E.B.) who was not blinded to pain management group. It was not possible to blind the assessor as pain management group was determined by the standard practice of each orthopedic surgeon.

Delirium was assessed using the CAM,[16] a validated diagnostic tool for the detection of delirium, in conjunction with the MMSE.[17] Pain was assessed using a numerical rating scale from 0 to 10, where 0 represented no pain, and 10 was the worst pain imaginable. This is a well-validated method of pain assessment and is an easy way for patients to describe their pain.[18,19] This tool was already in routine use on the orthopedic units.

Medication records were reviewed to record total amounts of opioid and other analgesics consumed over the 3 postoperative days. All opioids were converted to oral morphine equivalents.[20] Pharmacy acquisition costs (2010 Canadian dollars) in our facility are as follows: morphine 5 mg tablets $0.1411, hydromorphone 2 mg tablets $0.2155, oxycodone 5 mg $0.2620, oxycodone CR 5 mg $0.63, gabapentin 100 mg $0.0225, and celecoxib 100 mg $0.0582. For opioid costs, the unit cost of an equivalent amount of morphine was used; we are therefore underestimating costs, particularly in the multimodal group as oxycodone exceeds twice the cost of morphine. Acetaminophen costs (325 mg, $0.01) were not included as the dosing was the same for both groups and the cost is negligible. Mobilization was determined from physiotherapists' progress notes, noting how many days it took each patient to be able to ambulate with standby assistance only (ie, no hands-on assistance required).

Table 2. Postoperative Delirium, Total Morphine Equivalent Doses, and Pain Scores by Pain Management Approach.

	Traditional Pain Management (n = 54)	Multimodal Pain Management (n = 104)	*P*
Mean total morphine equivalent (mg)	166.4	442.3	$t = 10.64$, $P < .0001$
Total analgesic cost (per patient) over 3 days (Can$)	4.86	12.88	$t = 9.15$, $P < .0001$
Delirium (%)	8 (15%)	16 (15%)	$\chi^2 = 0.99$, $P = .92$
No delirium (%)	46 (85%)	88 (85%)	
Day 1 pain score (/10)	4.9	4.3	$t = 1.53$, $P = .13$
Day 2 pain score (/10)	4.4	3.8	$t = 1.46$, $P = .15$
Day 3 pain score (/10)	3.7	3.1	$t = 1.73$, $P = .09$
Mobility score (SBA or better on day 3)	58%	58%	

Abbreviation: SBA, standby assistance only.

Table 3. Mean Daily Pain Scores, Morphine Equivalents, and Delirium by Type of Surgery (Knee Versus Hip).

	Knee Surgery (n = 99)	Hip Surgery (n = 59)
Day 1		
Mean pain score (/10)	4.9[a]	4.0
Mean total morphine equivalent (mg)	122.5	124.8
Delirium (%)	7	10
Day 2		
Mean pain score (/10)	4.4[a]	3.4
Mean total morphine equivalent (mg)	117.7	116.6
Delirium (% delirious)	8	4
Day 3		
Mean pain score (/10)	3.6	2.9
Mean total morphine equivalent (mg)	97.7	103.5
Delirium (%)	2	5

[a]Knee surgery significantly more painful at postoperative day 1 ($t = 2.15$, $P = .03$) and day 2 ($t = 2.72$, $P = .007$); no other statistically significant differences.

Data Analysis

T tests were used to test continuous variables, such as age, opioid dose and cost, pain scores, and number of days to standby assistance mobility between patient groups. Chi-square testing was used to compare categorical variables such as gender, type of surgery, and presence or absence of delirium.

Results

Baseline characteristics of the traditional pain management group were compared to the multimodal group (Table 1). There were no statistically significant differences in age, sex, baseline MMSE, or pain scores. There were more total knee arthroplasties in the traditional pain management group and more total hip arthroplasties (THA) in the multimodal group, because of the practices of the surgeons included in each group.

The incidence of postoperative delirium was 15% in both groups. None of the recorded variables (age, sex, type of surgery, morphine equivalents, baseline, or postoperative pain scores) was found to be associated with the risk of delirium. With respect to mobility, 58% of both groups were considered safe with standby assistance by postoperative day 3 (Table 2).

There were no significant differences in self-rated pain scores on any postoperative days 1 to 3 between pain management groups. However, the multimodal group consumed significantly more opioids than the traditional group. The multimodal group received 442 mg of morphine equivalents, while the traditional group had 166.4 mg on average. Correspondingly, the cost of analgesic medications per patient is significantly higher in the multimodal group, as analgesic cost is driven by the cost of opioid consumed. This increase in cost is despite no difference in self-rated pain and despite our underestimating drug costs in the multimodal management group (Table 2).

Regardless of pain management group, knee surgery patients had significantly more pain on postoperative days 1 and 2 than THA patients. Despite this difference in pain scores, there was no significant difference in opioid use by arthroplasty type (Table 3).

Discussion

The most important finding of this observational study was that the amount of opioid used by the multimodal group was significantly higher than that used by the traditional regimen patients. This occurred despite similar pain scores and mobility outcomes and goes against the premise that multimodal regimens have an opioid-sparing effect for postoperative pain management. Larger opioid doses are associated with higher costs per patient, as demonstrated by our data, as well as the potential for increased adverse events. Although we did not identify any differences in the incidence of delirium, we did not document other known adverse effects such as nausea/vomiting, constipation, or hypotension in this study.

There was no significant difference in opioid consumption between hip and knee replacement patients, despite knee surgery being associated with more pain than hip arthroplasty. Interestingly, the traditional group underwent significantly more knee surgeries than the multimodal group, in which case higher pain scores and/or opioid doses might have been expected.

The incidence of delirium (15%) documented in elective arthroplasty patients in our data is similar to that reported previously.[1-4] The finding of no significant relationship between age, pain, or opioid use and delirium is surprising but may relate to sample size. In addition, there were elective surgery patients

in which delirium has been shown to occur less frequently in comparison to a frailer hip fracture population.[21,22]

The limitations of this study include a small sample size with a resultant decrease in power to detect differences in delirium. This is an observational study and it was not possible to blind the investigator completing the postoperative assessments. Nevertheless, we did find that the multimodal group received more than twice as much opioid medication, with no perceptible benefit on pain control or mobility, and at significantly increased cost. Although some previous reports suggests that multimodal pain management protocols are opioid sparing,[13] this is controversial and other data do not support this.[14,23]

Conclusion

Management of pain is an essential part of postoperative care. Given the growing elderly population who are increasingly frail and at a higher risk of delirium, controlling pain at the lowest possible doses of potentially deliriogenic medications is essential. The multimodal approach to pain control showed no benefit over the traditional approach, and we found that the amount of opioid consumed was significantly higher. This poses a potential risk in terms of tolerability in frail older individuals, and we demonstrated a direct increase in drug costs.

Declaration of Conflicting Interests

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