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ORIGINAL RESEARCH ARTICLE

Opioid Use and Pain Control in the Elderly After Elective or Urgent Orthopaedic Surgery: A Retrospective Cohort Study

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Abstract

Background As an increasing number of elderly are undergoing orthopaedic procedures, it is important to understand and evaluate postoperative pain management in this population, especially in regard to opioid use. Data in the literature pertaining to the very elderly remains scarce.

Objectives This study was conducted to evaluate whether older patients require lower opioid doses than their younger counterparts after undergoing an elective or urgent orthopaedic procedure, and to assess the cumulative incidence of adverse events and length of stay for each age group.

Methods A retrospective cohort study was performed to compare the mean opioid use and pain control between two groups of elderly patients (65–79 years and ≥ 80 years of age). The study included 250 patients who underwent either an elective arthroplasty or urgent orthopaedic surgery following a fracture. Data were collected during the 7 days following surgery.

Results No significant difference was found in mean and maximal pain scores between the two groups. Opioid use (expressed in intravenous morphine equivalents) was higher in the younger group. The difference reached statistical significance on the first postoperative day (subjects 65–79 years of age taking 21.3 mg, vs. 10.9 mg for the group over 80 years of age; mean difference 10.3 mg, 95% confidence interval 1.3–19.4). This was also observed in patients undergoing elective surgery on postoperative days 1, 5, 6 and 7. No difference in opioid use was observed between age groups in patients undergoing urgent surgery. Acute cognitive status deterioration, delirium, oxygen desaturation and constipation were observed more frequently in the older group, while mean length of stay was higher in the older group undergoing urgent surgery (8 vs. 17 days, $p < 0.001$).

Conclusions Our findings further support age-related differences in opioid requirements during the postoperative context after elective orthopaedic surgery, while no difference was found between age groups after urgent surgery.

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Key Points

Patients aged ≥ 80 years had lower opioid use than patients aged 65–79 years.

An age-related difference in opioid use was observed in patients undergoing elective surgery.

Opioid-related adverse effects were more frequent in patients aged ≥ 80 years.

1 Introduction

Older adults represent an important subset of patients who undergo an orthopaedic procedure, with total hip arthroplasty being one of the most common elective surgeries [1, 2]. These patients often require orthopaedic surgery, either for fractures secondary to falls or for longstanding osteoarthritis [2]. The absolute and relative number of elderly people in the population is sharply rising; the proportion of people over 60 years of age accounted for approximately 13% of the global population in 2017, and is expected to grow to 21% by 2050 [3, 4]. These demographic changes, in addition to the prevalence of elderly patients in the orthopaedic context, reinforce the importance of tailoring postoperative care to the older population.

Due to the presence of multiple comorbidities, frailty, polypharmacy, and altered pharmacokinetics and pharmacodynamics, prescribing analgesia for the elderly is often considered a challenging task for clinicians [5]. Opioids are often prescribed to provide adequate pain control following orthopaedic surgery. While treatment guidelines recommend a 'start low and go slow' approach to analgesic dosing in elderly patients, these guidelines provide no information on the appropriate initial doses of opioids in this population [6–8]. Opioid use can lead to detrimental side effects in older people, such as urinary retention, constipation and, more controversially, delirium [9, 10]. Untreated pain has also been associated with an increased risk of delirium and increased hospital length of stay [9–14]. Therefore, the impact of poor pain control needs to be taken into account when considering lower opioid dosage.

Few studies have evaluated the outcomes associated with opioid use for postoperative pain management in patients aged ≥ 80 years. In the general population undergoing surgery, it has been suggested that appropriate pain control could increase the rehabilitation potential or decrease the length of stay [15, 16]. Some studies suggest that elderly patients require lower opioid doses [17–21]. Petre et al. compared opioid use between patients aged 60–79 years and those aged ≥80 years after an elective orthopaedic surgery, and found that for a similar level of pain control, opioid requirements were lower in the older group but were associated with more adverse events [17]. Data regarding opioid use in very elderly patients undergoing orthopaedic surgery remains scarce, and guidelines do not precisely address pain control in this specific population, referring commonly to the elderly population at large. To our knowledge, no study evaluated age-related differences in opioid use after an urgent orthopaedic procedure (i.e. following a fracture).

This study was conducted to evaluate whether older patients require lower opioid doses than their younger counterparts after undergoing an elective or urgent orthopaedic procedure. Our objective was to compare the mean opioid dose and pain scores (mean and highest values) during the first 7 postoperative days between patients aged 65–79 years and ≥ 80 years following orthopaedic surgery. Our primary hypothesis was that the older group would require lower opioid doses for the same pain control. Secondary outcomes included the cumulative incidence of adverse events and length of stay for each age group.

2 Methods

2.1 Study Design, Setting and Participants

This retrospective cohort study was conducted in a tertiary care teaching hospital within the McGill University Health Centre. Patients aged 65 years and older who underwent an elective knee or hip arthroplasty or any orthopaedic surgery following a fracture were eligible. To be included, patients also needed to have received at least one dose of an opioid medication after surgery and to be admitted to the orthopaedic unit within the institution in the postoperative period. Patients who were admitted to an intensive care unit immediately after surgery were excluded from the study.

2.2 Data Extraction

Data were collected retrospectively from 1 March 2015 to 20 September 2015. Electronic and written hospital records were reviewed for all patients aged ≥ 65 years who had undergone orthopaedic surgery between 1 June 2014 and 20 August 2015 in order to identify patients who met the inclusion criteria. Data were collected for the day prior to and up to 7 days after the surgery by the investigators and research assistants.

Patients were divided into two age groups: those aged 65–79 years and those aged ≥ 80 years. Age categories were defined based on the previous study by Petre et al. [17]. However, a limit of 65 years of age was chosen for the younger group in order to focus on elderly patients, commonly defined as such by our national statistical institute, as well as the MEDLINE MeSH classification (aged 65–79 years; aged ≥80 years, including very elderly patients) [22]. The following information on study subjects was recorded: sex, weight, American Society of Anesthesiologists score, type of anaesthesia, type of surgery (presented as arthroplasty or stabilisation), surgical site, serum creatinine level at baseline and length of stay. Charlson scores were calculated to assess the burden of comorbidity [23]. The presence of dementia at baseline was also recorded, defined as documented dementia in the preoperative questionnaire, past medical history or use of an acetylcholinesterase inhibitor or *N*-Methyl-D-Aspartate (NMDA) receptor antagonist. Patients who were taking regular opioid therapy prior to surgery were identified. When available and applicable, information pertaining to preoperative pain scores (maximum and mean), presence of confusion, and delay between emergency admission and surgery were collected. Other pertinent collected data are presented in Appendix 1 in the Online Resource.

Opioid medication dosing was extracted from medication administration records in the patients' charts. As per institutional protocol, all patients undergoing elective arthroplasty of the knee or hip received fixed doses of oral or subcutaneous opioids, on an 'as needed' basis. As for patients undergoing urgent orthopaedic surgery following a fracture, oral or subcutaneous opioids were prescribed based on the clinician's experience. Patients could also receive intravenous opioids through patient-controlled analgesia (PCA), and this was accounted for in our study. All opioid dosages were converted to the equivalent intravenous morphine dose [24]. The use of other non-opioid analgesics and co-analgesia was also recorded (see Appendix 1 in the Online Resource). Pain scores were reported by patients on a numeric rating scale ranging from 0 to 10, and recorded by nursing staff during each shift. All pain scores from post-anesthesia care to postoperative day 7 were included in the study data.

Medical records were reviewed to identify adverse events that could have resulted from opioid use: acute deterioration in cognitive status (any of the following events documented by a physician or nurse: change in mental status, increased confusion, agitation, restlessness, hallucinations; or change in disorientation in person, place or time; or delirium), respiratory distress, oxygen desaturation, nausea or vomiting, constipation, urinary retention, sedation and fall. Delirium was defined as a documented medical diagnosis of delirium in the chart or a positive Confusion Assessment Method (CAM) score (see Appendix 2 in the Online Resource for a complete definition).

2.3 Data Analysis

Descriptive statistics were used to compare patients' characteristics according to their age group, and Fisher's exact test was used to assess differences between elective and urgent surgery populations. Two-way analysis of variance (ANOVA) was used to identify differences between the subgroups for each variable. Student's *t* test was used to compare continuous variables, while the Mantel–Haenszel test was used for categorical variables.

Differences in pain scores (mean and maximum) and opioid use were assessed for postoperative days 1–7, using covariance analysis models (ANCOVA), with age group and surgical context as between-subject factors. These analyses included several covariables that were chosen based on previous tests if statistical differences between age groups were identified (see Appendices 1, 8 and 9 in the Online Resource. An interaction term was also incorporated into the analysis to assess the modulating effect of the surgical context (elective vs. urgent) on the impact of age group on primary outcomes. Prespecified subgroup analyses were also performed according to the surgical context. Statistical analyses were conducted using IBM SPSS Statistics version 22 (IBM Corporation, Armonk, NY, USA). Safety was assessed by comparing the cumulative incidence of adverse effects during the postoperative period (from postoperative days 0–7). Statistical significance was set at 5% for each analysis. Statistical analyses for the Fisher's test were performed using Microsoft Excel 2008 for Mac, version 12.3.6 (Microsoft Corporation, Redmond, WA, USA). No adjustment for multiplicity of tests was carried out.

The calculation of the sample size was based on the difference of opioid use reported in the study by Petre et al. [17]. The authors reported a difference of 8.2 mg (of equivalent intravenous morphine) in daily opioid use between the age groups. To ensure a power of 80% to detect a similar difference in our study groups, with a two-sided alpha of 0.05 and a standard deviation of 23.3, 117 patients were required for each age group.

3 Results

A total of 327 surgeries were screened, of which 250 met the inclusion criteria (see Appendix 3 in the Online Resource). In the younger group (65–79 years), 123 patients underwent 134 procedures, whereas 111 patients in the older group (≥ 80 years) underwent 116 procedures. Patients in the older group were more likely to suffer from dementia and chronic kidney disease (Table 1). No differences in postoperative non-opioid analgesia use were found between age groups (see Appendix 1 in the Online Resource).

After adjusting for surgical context, type of anaesthesia, baseline dementia and acute deterioration in cognitive status, no significant difference was found in mean and maximal pain scores between the younger and older groups over each of the first 7 postoperative days (see Appendices 4 and 5 in the Online Resource). Similar observations were made when comparing pain scores between age groups in the elective and urgent contexts. Adjusted pain scores are presented in Fig. 1a.

Unadjusted means for opioid use were higher in the younger group when compared with the older group for postoperative days 1–7 (Fig. 1b). This was also observed when adjusting for surgical context, type of anaesthesia, intraoperative analgesia, baseline dementia and acute cognitive dysfunction (see Appendix 6 in the Online Resource). This outcome was not adjusted for the presence of chronic kidney disease as it may lead to overadjustment bias. This difference was statistically significant on postoperative day 1 for the entire cohort (mean difference 10.3 mg, 95% confidence interval [CI] 1.3–19.4). Opioid use was lower in the younger group on postoperative day 3, although the difference was

Table 1 Demographics and clinical features

Characteristic	Urgent		Elective		Total		*p* value
	Age 65–79 years (*n* = 48)	Age ≥ 80 years (*n* = 65)	Age 65–79 years (*n* = 86)	Age ≥ 80 years (*n* = 51)	Age 65–79 years (*n* = 134)	Age ≥ 80 years (*n* = 116)	
Age, years [mean (range)]	71 (65–79)	86 (80–101)	72 (65–79)	84 (80–90)	72 (65–79)	85 (80–101)	NA
Female sex [*n* (%)]	32 (67)	49 (75)	47 (55)	29 (57)	79 (59)	78 (67)	0.479
Weight, kg[a] [mean (SD)]	62 (9.7)	61 (23.1)	82 (12.7)	74 (14.4)	78 (14.4)	70 (19.1)	[a]
BMI, kg/m^2 [mean (SD)]	23 (3.6)	24 (11.9)	29 (4.3)	27 (5.2)	28 (4.7)	26 (7.7)	0.47
ASA score [mean (SD)]	2.72 (0.71)	2.80 (0.54)	2.14 (0.53)	2.26 (0.53)	2.35 (0.66)	2.56 (0.6)	0.20
Dementia [*n* (%)]	3 (6.3)	17 (26.2)	0 (0)	2 (3.9)	3 (2.2)	19 (16.4)	0.003
CKD, moderate to terminal[b] [*n* (%)]	3 (6.3)	24 (36.9)	12 (14.0)	15 (29.4)	15 (11.2)	39 (33.6)	< 0.001
Charlson score[c] [mean (SD)]	1.8 (2.4)	1.9 (1.7)	0.51 (1.1)	0.9 (1.4)	0.99 (1.8)	1.5 (1.6)	0.21
Type of surgery [*n* (%)]							
Arthroplasty	6 (12.8)	18 (27.7)	88 (100)	51 (100)	92 (68.7)	69 (59.5)	0.097[d]
Stabilisation	41 (87.2)	47 (72.3)	0 (0)	0 (0)	42 (31.3)	47 (40.5)	
Surgical site [*n* (%)]							
Hip	14 (29.2)	42 (64.6)	34 (39.5)	21 (41.2)	49 (36.6)	63 (54.3)	0.859[e]
Knee	0 (0)	1 (1.5)	52 (60.5)	30 (58.8)	52 (38.8)	31 (26.7)	
Other	34 (70.8)	22 (33.9)	0 (0)	0 (0)	34 (25.4)	22 (19.0)	
Type of anesthesia [*n* (%)]							
General	32 (66.7)	34 (52.3)	8 (9.3)	8 (15.7)	40 (29.9)	42 (36.2)	0.739
Epidural or spinal	12 (25.0)	38 (58.5)	81 (94.2)	47 (92.2)	93 (69.4)	85 (73.3)	0.007
Local	11 (22.9)	12 (18.5)	19 (22.1)	23 (45.1)	30 (22.4)	35 (30.2)	0.095
Type of co-analgesia [*n* (%)]							
Acetaminophen[g]	39 (81.3)	56 (86.2)	85 (98.8)	50 (98.0)	124 (92.5)	106 (91.4)	[f]
NSAID[h]	10 (20.8)	14 (21.5)	73 (84.9)	42 (82.4)	83 (61.9)	56 (48.3)	[f]
Other oral co-analgesia[i]	9 (18.6)	8 (12.3)	8 (9.3)	6 (11.8)	17 (12.7)	14 (12.1)	[f]
Neuroaxial anesthesia	1 (2.1)	4 (6.2)	2 (2.3)	2 (3.9)	3 (2.2)	6 (5.1)	[f]
Peripheral nerve block	11 (22.9)	8 (12.3)	53 (61.6)	26 (51.0)	64 (47.8)	34 (29.3)	[f]

ASA American Society of Anesthesiologists, *CKD* chronic kidney disease, *GFR* glomerular filtration rate, *MDRD* Modification of Diet in Renal Disease equation for GFR estimation, *NSAID* non-steroidal anti-inflammatory drug, *NA* not applicable, *PACU* post-anesthesia care unit, *SD* standard deviation, *BMI* body mass index

[a]Only 41.6% and 46.1% of weights were available for urgent surgery for the 65–79 years and ≥ 80 years age groups, respectively, vs. 97.7% and 100% in elective surgery

[b]GFR < 60 mL/min/1.73 m^2, estimated using the MDRD formula [31]

[c]Original Charlson score, which does not include an age component

[d]Type of surgery was dichotomised into arthroplasty or stabilisation

[e]Statistical comparison was only performed for elective surgery, where surgical sites only included the hip and knee. The statistical comparison could not be performed in the urgent group due to the multitude of surgical sites present in the urgent group

[f]Statistical comparison for these variables was performed for each postoperative day. Data are presented in the Appendix 1 in the Online Resource. The presence of neuroaxial anesthesia in the PACU was the only variable with a p value < 0.05

[g]Presence of more than 1.5 g of acetaminophen per day, with a mean daily dose of acetaminophen of 2.15 g/day

[h]Among NSAID use, celecoxib was mainly used (71% of NSAIDs; mean daily dose 231 mg), followed by ketorolac (18%; mean daily dose 24 mg) and naproxen (10%; mean daily dose 709 mg)

[i]Duloxetine, gabapentin, pregabalin and tricyclic antidepressants

not significant (mean difference: − 2.1 mg, 95% CI − 7.2 to 3.0).

Analyses also revealed a significantly higher opioid use for the younger group undergoing elective surgery for postoperative days 5–7 (mean difference 13.1 mg, 95% CI 5.8–20.5; mean difference 14.2 mg, 95% CI 5.5–22.9; and mean difference 27.5 mg, 95% CI 14.8–40.1, for postoperative days 5, 6 and 7, respectively) (see Fig. 1c and

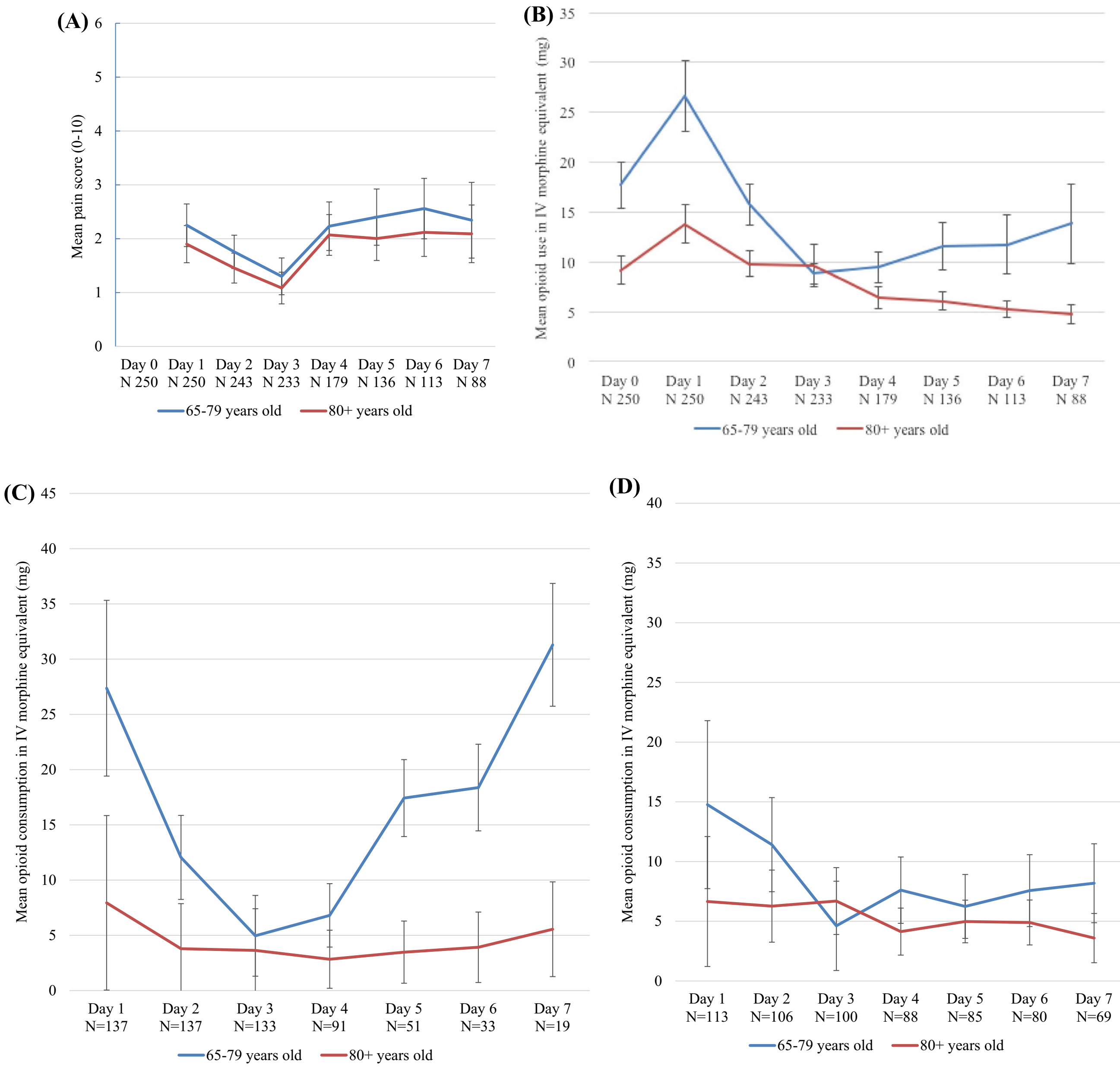

Fig. 1 **a** Adjusted mean pain score; **b** unadjusted mean opioid use in IV morphine equivalent (in mg); **c** adjusted mean opioid use in IV morphine equivalent (in mg) in an elective context; and **d** adjusted mean opioid use in IV morphine equivalent (in mg) in an urgent context. Data shown are mean ± 1 standard error. *IV* intravenous

Appendix 6 in the Online Resource). No difference in opioid use was observed between age groups for patients undergoing urgent surgery (see Fig. 1d and Appendix 6 in the Online Resource).

The cumulative incidence of adverse events was slightly higher in the older group versus the younger group (78.5% vs. 74.6%), and these patients were more likely to develop acute deterioration in cognitive status (including delirium), oxygen desaturation and constipation (Table 2). Almost half of the patients (49.2% and 49.2%, respectively) in the older group were noted to have acute deterioration in cognitive status and constipation if they were undergoing urgent surgery. On the other hand, when looking at both elective and urgent surgeries, respiratory distress and nausea or vomiting were more frequent in the younger group versus the older group. Mean length of stay was significantly higher in the older group versus the younger group for the entire study cohort (12 vs. 6 days, $p < 0.001$), as well as in the urgent subgroup (17 vs. 8 days, $p < 0.001$),

Table 2 Adverse event cumulative incidence

Adverse event	Urgent		Elective		Total	
	Age 65–79 years ($n = 48$)	Age ≥ 80 years ($n = 65$)	Age 65–79 years ($n = 86$)	Age ≥ 80 years ($n = 51$)	Age 65–79 years ($n = 134$)	Age ≥ 80 years ($n = 116$)
Acute deterioration in cognitive status, including delirium[a]	11 (22.9)	32 (49.2)	5 (5.8)	9 (17.6)	16 (11.9)	41 (35.3)
Delirium[a]	5 (10.4)	17 (26.2)	1 (1.2)	2 (3.9)	6 (4.5)	19 (16.4)
Respiratory distress or arrest[a]	0 (0)	0 (0)	4 (4.7)	1 (2.0)	4 (3.0)	1 (0.9)
Oxygen desaturation[a]	11 (22.9)	14 (21.5)	5 (5.8)	10 (19.6)	16 (11.9)	24 (20.7)
Nausea or vomiting[a]	22 (45.8)	25 (38.5)	53 (61.6)	22 (43.1)	75 (56.0)	47 (40.5)
Constipation[a]	15 (31.3)	32 (49.2)	23 (26.7)	14 (27.4)	38 (28.4)	46 (39.7)
Urinary retention	19 (39.6)	14 (21.5)	12 (14.0)	13 (25.5)	31 (23.1)	27 (23.3)
Fall	2 (4.2)	1 (1.5)	1 (1.2)	2 (3.9)	3 (2.2)	3 (2.6)
Any[a,b]	37 (77.1)	54 (83.1)	63 (73.3)	37 (72.6)	100 (74.6)	91 (78.4)

Data are expressed as n (%)

Difference between the two age groups (65–79 years vs. ≥ 80 years) in the total cohort

[a]Fisher's exact test was statistically significant ($p < 0.001$)

[b]Presence of acute deterioration in cognitive status, including delirium; respiratory distress or arrest; oxygen desaturation; nausea or vomiting; constipation; urinary retention; fall

while it did not differ in either age group when looking at elective surgeries (5 vs. 4 days, $p = 0.662$).

4 Discussion

This retrospective cohort study investigated the relationship between age, pain and opioid use in the postoperative period following orthopaedic surgery. In our study, and as previously observed in other studies [17–20], the older group had lower opioid use than the younger group, while still maintaining the same level of pain control. This remained true after adjusting for potential confounders. Mean pain score was not used as a confounder for opioid use as these two variables may have a mutual causal effect on each other. It is difficult to ascertain which variable precedes the other in a causal pathway. Verification of the mean pain score and the maximal pain score as sensitivity analysis was performed to detect any discrepancy between groups (see Appendix 5 in the Online Resource). However, the difference in opioid use between age groups diminishes progressively throughout postoperative days 1–4. This may be explained by the overall reduction in opioid use after the initial postoperative period as pain is expected to diminish over time as patients recover [25].

No statistically significant difference in opioid use was observed between age groups for those who underwent urgent surgery throughout the postoperative period. These different findings between surgical contexts are most likely explained by the heterogeneity of fractures included in our study. As reported in Table 1, the proportion of patients in the older group (64.6%) who underwent urgent surgery for hip fractures was much higher than in the younger group (29.2%). Up to 55 specific types of fracture were reported in our study, further adding to the confounding effect of the type of fracture on the study outcomes in the urgent group. This could not be accounted for in our statistical models. Furthermore, the pathophysiology of pain may differ between patients with chronic pain and those with acute pain. As suggested by Uthaikhup et al., central sensitisation of pain may not be present in elderly patients with chronic pain [26]. As this process is less significant in patients with acute fracture [27], it may explain why the difference in opioid use was not observed in this group of patients.

Petre et al. also evaluated the difference in opioid use between similar age groups during the postoperative period following total knee or hip arthroplasty. Their results were consistent with our findings as they reported significantly higher daily opioid use in the younger group after adjusting for pain (16.4 mg vs. 8.2 mg) [17].

Multiple studies have suggested that elderly patients are more sensitive to opioid-related adverse events [28, 29]. In our study, patients aged ≥ 80 years were more likely to develop acute deterioration in cognitive status, delirium, oxygen desaturation and constipation despite lower opioid use, compared with younger patients. The cumulative incidence of constipation was significantly higher in the older group that underwent urgent surgery, but was similar between other subgroups. It is likely that the mean length of stay in this subgroup far exceeded the length of stay of the other subgroups, allowing clinicians to detect more cases of constipation in these patients over time. As observed in a previous study [13], elderly patients were more likely to develop acute cognitive deterioration and delirium during the postoperative period; however, this finding may be due to the much higher prevalence of dementia in the older group.

Our study had several limitations. Due to the retrospective design of the study, our results were influenced by incomplete charting of patient information. This was especially problematic for pain scores that were not always routinely documented. Data pertaining to level of sedation and patient's weight were also often missing, rendering these variables unusable for statistical analysis. The inconsistent documentation of chronic opioid use may have further influenced our results as it is known to be associated with increased opioid requirements due to opioid tolerance [30]. Unfortunately, these data were missing for the majority of our cohort (66%) as a valid 'home' medication list was unavailable in patient charts. As there was no adjustment for multiplicity of tests, there may be some false positives or negatives in our results. Finally, our study may have been underpowered to detect differences in the urgent group due to the variety of fracture types, as mentioned previously. This could be addressed by selecting specific types of fracture as part of the study inclusion criteria.

Among secondary outcomes, the retrospective design of the study may have also affected our results. For diagnostic of delirium as an example, not all patients with delirium may have been detected, especially those with hypoactive delirium. This is likely reflected by the higher percentages of 'acute deterioration in cognitive status' compared with documented delirium diagnoses. The fact that we did not exclude patients with known dementia for this variable is also a limitation as these patients are particularly at risk for this complication. When descriptively analyzing the urgent surgery subgroup (as only three cases of delirium were documented in the elective subgroup), older patients developed delirium more frequently than the younger group, but the patients with dementia had a higher incidence (33% for patients aged 65–79 years, and 53% for patients aged ≥ 80 years) than those without known cognitive disorder (9% for patients aged 65–79 years, and 17% for patients aged ≥ 80 years). The possible presence of delirium prior to surgery is also limiting; however, it was not possible to exclude these patients as their identification was difficult. Although we documented the presence of preoperative confusion for the urgent surgery group (which was not statistically different between groups), it was not possible to retrospectively assess if this was a baseline or new change in status.

5 Conclusions

Very few studies have evaluated age-related differences in systemic opioid use in the week following orthopaedic surgeries in patients aged ≥ 65 years, especially in the very elderly. Our study supports previous findings of decreased opioid needs in older patients after elective procedures. Considerable side effects were also noted in our study, mostly in the older group despite their lower opioid use. However, patients' characteristics and postoperative management may greatly differ between the elective and urgent contexts. Therefore, it is important to further evaluate age-related differences in opioid use in patients undergoing surgery following a fracture, given higher susceptibility to adverse effects and longer time for recovery. Proper pain management remains a challenge as frailty is common in the older patient and complicates opioid dosing.

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Author contributions VDB and JFT were responsible for the study concept and design, collection and analysis of data, interpretation of results and preparation of the manuscript. LPF assisted with the study concept and design, analysis of data, interpretation of results and editing of the manuscript for important intellectual content.

Compliance with Ethical Standards

Conflicts of interest Vincent Dagenais-Beaulé, Jean-François Tourigny and Louise Papillon-Ferland have no conflicts of interest directly relevant to the content of this article.

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Ethical approval Institutional Ethics Board approval was obtained for this study.

Informed consent For this type of study, formal consent is not required, as deemed by our Institutional Ethics Board.

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