e-ISSN (online): 2745-9497

Journal of Anesthesiology and Clinical Research (JACR)

Journal website: https://hmpublisher.com/index.php/jacr

Age as Consumption Factor in Morphine Patient-Controlled Analgesia (PCA) for Knee Ligamentoplasty

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ARTICLE INFO

Keywords:
Age
Consumption
Factors
Ligamentoplasty
Morphine

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The author has reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/jacr.v4i2.382

A B S T R A C T

Introduction: The consumption of morphine, or any other opioid analgesic, can be influenced by various factors, including age and sex. These factors play important roles in how individuals respond to and metabolize opioids, which can have implications for their pain management and potential risks associated with opioid use. The study was to investigate the relationship between age and total morphine consumption during knee ligamentoplasty with the use of three analgesic techniques. **Methods:** The study included 165 patients undergoing primary reconstruction of the anterior cruciate ligament of the knee. All patients underwent spinal anaesthesia. The first group, systemic analgesia (SA), received balanced systemic analgesia postoperatively for a minimum of five days, based on Paracetamol, Diclofenac and a morphine PCA. In addition to the systemic analgesia already described, the second group, femoral analgesia (FA), will benefit from a femoral peri-nervous catheter in the crural position. 20 ml of bupivacaine at 0.125% concentration is injected; maintenance is set up immediately with a continuous flow of 8 ml/h for 36 h. The third intra-articular analgesia (IAA) group received, in addition to the same systemic analgesia, an infusion through an epidural catheter of 20 ml of 0.125% bupivacaine, followed by maintenance with 8 ml/h of the same local anesthetic via an electric syringe pump for 36 h. **Results:** Cumulative morphine consumption was assessed, as was pain at rest using a numerical scale (EN) from 1 to 10. Data were collected from H0 to H36. Overall consumption was 15.13 ± 12.35 mg. The difference in consumption was not significant according to gender and ASA, but it was significant according to mean age. There was a negative correlation between age and morphine consumption, with Pearson's R at -0.19 p 0.016. **Conclusion:** Morphine consumption kinetics follow those of post-operative pain and its intensity, but also of other factors, including the patient's age. Young age is one of the criteria for over-consumption of morphine.

1. Introduction

Knee ligamentoplasty is classified as a moderately to severely painful surgery, and management of this pain is more than imperative. Knee ligamentoplasty is widely recognized as a moderately to severely painful surgical procedure, and the effective management of postoperative pain is of utmost importance. Patients who undergo knee ligamentoplasty often experience varying degrees of pain, discomfort, and functional limitations in the immediate aftermath of the surgery. To ensure a successful recovery and improve the overall patient experience, it is imperative to employ robust pain management strategies tailored to the specific needs of these individuals. The significance of adequate pain management in knee ligamentoplasty lies not only in enhancing patient comfort but also in promoting early mobilization and rehabilitation. the significance of adequate pain management in knee ligamentoplasty goes well beyond just enhancing patient comfort. It plays a pivotal role in promoting early mobilization and rehabilitation, and this has far-reaching implications for the overall success of the procedure and the patient's recovery.[1,2]

Effective pain management enables patients to participate more actively in their postoperative rehabilitation. It reduces the fear of pain and discomfort, encouraging patients to engage in physical therapy exercises that are essential for regaining strength, range of motion, and function in the affected knee. Immobility and inadequate rehabilitation can lead to a range of complications, including muscle atrophy, joint stiffness, and even a risk of blood clots. Proper pain management that supports early mobilization can significantly reduce these risks. By reducing pain, patients are more likely to regain their mobility faster. This means a quicker return to daily activities, work, and, in many cases, sports and other physically demanding pursuits. Shortening the recovery period can improve the patient's quality of life and decrease the economic burden of a lengthy rehabilitation. Patients who experience less pain and a faster return to normal activities tend to be more satisfied with their surgical outcomes. High patient satisfaction can boost the reputation of the surgical team and the healthcare facility and lead to positive word-of-mouth referrals. Prolonged hospital stays and extensive rehabilitation due to poor pain management can substantially increase healthcare costs. Effective pain management can help reduce these costs by streamlining the recovery process. When pain is managed effectively, patients are more likely to engage in physical therapy and regain their mobility, ultimately facilitating a quicker return to their daily activities and sports participation. Failure to address pain adequately can lead to prolonged recovery periods, increased healthcare costs, and potential complications.[3,4]

The consumption of morphine, or any other opioid analgesic, can be influenced by various factors, including age and gender. These factors play important roles in how individuals respond to and metabolize opioids, which can have implications for their pain management and potential risks associated with opioid use.[5] The study was to investigate the relationship between age and total morphine consumption during knee ligamentoplasty with the use of three analgesic techniques.

2. Methods

The study was a prospective study carried out in the orthopedic unit of the University Hospital of Sétif. A population of adults was admitted during the study period for primary reconstruction surgery of the anterior cruciate ligament of the knee. Inclusion criteria in this study were **c**onsenting patients and those admitted for anterior cruciate ligament rupture. Exclusion criteria were patient refusal, surgical revision, alternative indications for ALR, local or systemic infection, patient on anticoagulants, allergy to local anaesthetics and contraindications to non-steroidal anti-inflammatory drugs. During the study period, 173 patients were admitted for knee ligamentoplasty, of whom eight were excluded: five refused spinal anaesthesia, two repeat surgeries and one contraindication to diclofenac. A total of 165 cases were included, divided into three study groups by drawing lots. All patients underwent spinal anesthesia with 12.5 mg bupivacaine 0.5% + 25 ug clonidine. After surgery, patients were clearly informed of the three analgesic procedures and how the PCA device worked, and informed consent was obtained: The first group (AS) will receive systemically balanced analgesia postoperatively for a minimum of five days, based on : paracetamol at a dose of 1g every 6 hours per oral, diclofenac 50 mg every 12 hours per oral and a morphine PCA with a concentration of 1mg /ml and a refractory period of 7 min. In addition to the systemic analgesia already described, the second group (AF) will benefit from a femoral peri-nervous catheter in the crural position for a minimum of five days, with the same dosage: 20 ml of 0.125% bupivacaine is injected at a maintenance rate of 0.8 ml/hour. The third group (AIA) will receive, in addition to the same systemic analgesia already described, through an epidural catheter placed intra-articularly by the surgeon at the end of the operation after the closure of the joint capsule, 20 ml of 0.125% bupivacaine through the antibacterial filter. Maintenance is also performed immediately with 8 ml/h of the same local anesthetic via an electric syringe pump for 36 hours.

The following criteria were prospectively collected during hospitalization, in immediate postoperative, and until catheter removal: Quantitative: cumulative

morphine consumption Qualitative: estimation of pain at rest using a numerical scale (EN) from 1 to 10. Data were collected on a data sheet at 2 h, 4 h, 6 h, 8 h, 12 h, 16 h, 20 h, 24 h, 28 h, 36 h, d1, d2, d3, d4 and d5. (T0: injection of local anesthetic for both the AF and AIA groups and the patient's installation at the post-operative level for the AS group). Results were analyzed using SPSS statistics 26 software. The study uses both descriptive and analytical statistical techniques. The cohort was stratified by mean age into two groups: under 30 and over 30.

3. Results and Discussion

Over the study period, 165 patients were included in the study protocol, divided by random selection into three groups of 55 patients. The characteristics are reported in Table 1. The average age of our patients was 30.00 ± 7.30 years, with extremes ranging from 17 to 52 years. The age groups most represented in our series were 20 to 24, 25 to 29, and 30 to 34.

Table 1. Demographic data by study group.

Groups	**Total (N = 165)**	**Systemic balanced analgesia(n=55)**	**Femoral perinerve (n=55)**	**Continuous intraarticular (n=55)**	**P**
Age	30± 7,30	29,36 ± 6,75	30,16±7,93	30,47 ± 7,28	0.716
Gender: Male Female	 161 (97,6%) 4 (2,4%)	 54 (33,5%) 1 (25%)	 53 (32,9%) 2 (50%)	 54 (33,5%) 1 (25%)	0,774
ASA: ASA 1 ASA 2	 158 (95,8%) 7 (4,2%)	 54(33,5%) 1 (25%)	 52 (32,91%) 3 (42,86%)	 52 (32,91%) 3 (42,86%)	0,551

Consumption was lower in the AF (femoral peri-nerve) group, and the difference was statistically significant with an F = 3.539(2) and a p = 0.031. The post-hoc test shows a difference in mean of 6.12 ± 2.41 between the AS and AF groups with a significant p = 0.012, a difference in mean of 1.67 ± 2.41 with a non-significant p = 0.49 between the AF and AIA groups and a difference in mean of 4.45 ± 2.31 with a p = 0.056 at the limit of significance between the AS and AIA groups. Overall consumption was 15.13 ± 12.35 mg. This mean was 15.09 ± 12.45 for the male gender versus 17.33± 4.51 for the female gender, but the difference was not statistically significant with a t = -0.311(155) and a p= 0.757. ASA 2 patients consumed less morphine (10.85 ± 10.02) compared with ASA 1 (15.33 ± 12.44), but the difference was not significant with a t = 0.937 (155); p = 0.350. Average morphine consumption by age group is shown in Table 2. The difference was statistically insignificant on ANOVA with F = 1.806(6) and p = 0.102. Morphine consumption was highest in the 25-29 and 30-35 age groups. There was a significant but weak inverse correlation between morphine consumption and patient age, with a Pearson correlation R = -0.191 and a p = 0.016. Patients aged less than or equal to 30 years had a mean morphine consumption of 17.39 ± 13.32 mg, compared with patients aged over 30 years with a mean of 11.48 ± 9.60 mg. The difference was statistically significant, with F = 8.91 and p =0.003. The odds ratio was 1.95 [0.99- 3.82]; thus, the risk of morphine consumption was multiplied by 02 for the age group ≤ to 30 years compared to the age group > to 30 years.

Age can impact how opioids are metabolized in the body. In general, older individuals may metabolize opioids more slowly than younger individuals due to changes in liver function and overall metabolism. This can lead to a need for lower doses in older patients to achieve the same level of pain relief. Additionally, older patients may develop tolerance more slowly, which can mean that the same dose of morphine remains effective for a longer period. Older individuals may be more sensitive to the side effects of morphine, such as dizziness, sedation, and constipation. Careful dosing and monitoring are necessary to minimize these adverse effects.[6,7]

Table 2. Total morphine consumption by age group.

Age	Average	N	Standard deviation
17-19 years	12,0000	2	11,31371
20-24 years	15,1282	39	11,63068
25-29 years	17,6905	42	14,00085
30-34 years	17,4474	38	13,24141
35-39 years	8,8125	16	8,39221
40-44 years	12,0714	14	8,80091
45 and over	7,6667	6	8,16497
Total	15,1338	157	12,34966

There are differences in the ways men and women metabolize opioids, including morphine. Some studies have shown that women tend to metabolize morphine more quickly, which may require higher doses for adequate pain relief in some cases. Hormonal fluctuations in women, such as those related to the menstrual cycle or pregnancy, can affect pain perception and opioid sensitivity. Healthcare providers may need to adjust dosages to account for these variations. Research suggests that men may be at a higher risk for opioid misuse and addiction. Therefore, healthcare providers may take into consideration the sex of the patient when prescribing opioids and may implement stricter monitoring in certain cases.[8-10]

4. Conclusion

Morphine consumption kinetics follow those of post-operative pain and its intensity but also of other factors, including the patient's age. Young age is one of the criteria for over-consumption of morphine.

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