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Use of chloroprocaine in orthopedic day surgery: a brief report in a cohort of patients undergoing knee arthroscopy

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Abstract. – OBJECTIVE: Spinal anesthesia with local anesthetics is a viable alternative to general anesthesia in orthopedic surgery, and it is currently considered the standard of care for knee arthroscopy. The use of chloroprocaine may offer several potential advantages over other local anesthetics, including, above all, its rapid onset and short duration of action. The aim of the present retrospective study is to evaluate the post-surgical outcomes of patients who underwent knee arthroscopy using spinal anesthesia with chloroprocaine in an outpatient orthopedic setting.

PATIENTS AND METHODS: Data from patients who underwent elective knee arthroscopy between January 2022 and December 2022 were collected for the present study. Spinal anesthesia with chloroprocaine 10 mg/mL was administered in the designated subarachnoid space (L3-L4 in the majority of patients). A dosage of 40 mg was used to obtain a satisfactory sensory and motor block.

RESULTS: A total number of 302 patients met the inclusion criteria. No complications were reported during surgery in the present series of patients. None of the patients required bladder catheterization. In 84% of cases, the PADSS (Post-Anesthetic Discharge Scoring System) score at discharge was 10, whereas in 16% of cases, the PADSS score was 9. The mean time from anesthesia induction to first urination was 75±9.4 minutes, while the mean time from the anesthesia induction to the discharge from the hospital was 152±18.5 minutes.

CONCLUSIONS: Spinal chloroprocaine for knee arthroscopy demonstrated a short motor block duration, resulting in a fast time to discharge. These limited data show that chloroprocaine may be safely and effectively applied in outpatient knee arthroscopy procedures. However, more studies, possibly with a randomized design, are required to confirm these findings.

Key Words:
Knee, Arthroscopy, Spinal anesthesia.

Introduction

Spinal anesthesia with local anesthetics is a viable alternative to general anesthesia in orthopedic surgery[1], and it is currently considered the standard of care for knee arthroscopy[2-4]. It is contraindicated only in a few cases, including allergy to local anesthetics, increased intracranial pressure, shock, severe valvular stenosis, patient refusal, and infection at the site of injection.

Chloroprocaine hydrochloride, an aminobenzoic acid ester, is nowadays used for spinal anesthesia in a variety of surgical settings, including orthopedic, gynecological, and urological surgery[5,6]. As a matter of fact, the use of chloroprocaine may offer several potential advantages over other anesthetics. Firstly, its rapid onset allows for a fast sensory and motor block. Secondly, its short duration of action accounts for a rapid post-surgical recovery of the patient, which makes it an ideal choice for short procedures lasting up to 40 minutes[7]. Finally, its use is associated with a significantly lower risk of side effects, such as hypotension, urinary retention, and delayed resolution of sensory and motor blocks, as compared to the other commonly used long-acting local anesthetics, such as bupivacaine[8-12]. Even though systemic toxicity is unlikely to occur when chloroprocaine is administered at the recommended dosage, its efficacy and safety profiles should be carefully evaluated in view of the specific clinical setting. In fact, although rare, the most severe side effects

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include hyperthermia, cardiac arrhythmias, and seizures[13]. Furthermore, chloroprocaine should be cautiously used in patients with renal or hepatic failure and avoided in patients allergic to local anesthetics[14]. Moreover, the choice of the appropriate dosage varies according to the patient's characteristics (physical condition and concomitant administration of other drugs) and the duration of the surgery. The currently approved drug formulation is available at a 10 mg/mL concentration in 5 mL vials (50 mg, 1%). The maximum recommended dose is 50 mg[6,15]. However, since its dosage and duration of action strictly depend on the patient's individual factors, then the anesthesiologist's expertise and knowledge of the patient's physical condition play a fundamental role in selecting the right dose needed to achieve the anesthesia's positive outcome.

The aim of the present retrospective study is to evaluate the post-surgical outcomes of patients who underwent knee arthroscopy using spinal anesthesia with chloroprocaine in an outpatient orthopedic setting.

Patients and Methods

Study Design and Patients

Data of patients who underwent elective knee arthroscopy were collected for the present study. All the selected patients were treated at a single urban tertiary center by the same surgeons between January 2022 and December 2022. Once the study was approved by the Ethics Committee of IRCCS Humanitas Research Hospital (ID: 2390/2023), each patient signed an informed consent during the pre-operative visit for the use of his/her anonymized data for scientific purposes. During that period, bupivacaine was the institutional standard of care for spinal anesthesia, and the surgical and anesthesiologic teams selected the patients eligible for the use of chloroprocaine on an individual basis. None of the selected patients underwent a switch to general anesthesia. The inclusion criteria were patients undergoing elective knee arthroscopy for meniscal procedures (e.g., meniscectomy or meniscal suturing), loose body removal, intra-articular synovial biopsies, minor cartilage treatments (e.g., debridement or microfractures); physical status Class I or II according to the American Society of Anesthesiologists (ASA) score. The exclusion criteria were: International Normalized Ratio >1.3, platelet count <75,000, ongoing therapy with blood thinners, skin diseases at the injection site, neurological diseases (e.g., spinal stenosis or neuropathies), cardiac insufficiency, renal failure, chronic pain syndromes, a history of drug or alcohol addiction, and pregnant or lactating status in women.

Anesthesiologic Procedure

Spinal anesthesia was performed using a Whitacre 25G needle (BD®, Franklin Lakes, NJ, USA) with the patient in a lateral decubitus position (with the limb to be operated facing upwards). After setting up a sterile field, chloroprocaine 10 mg/mL in 5 mL vials (50 mg, 1%) was administered in the designated subarachnoid space (L3-L4 in the majority of patients). A dose of 40 mg was used to obtain a satisfactory sensory and motor block[6]. A pinprick test with a hypodermic needle (25G needle, AnHui Hongyu Wuzhou Medical Manifacturer, China) was used to assess the readiness for surgery. Motor block was assessed through the modified Bromage scale (0 = no motor block, able to raise a straight leg; 1 = unable to raise a straight leg but able to flex the knee and ankle, 2 = unable to flex the knee but able to flex the ankle; and 3 = complete motor block). During the surgery, the spinal anesthesia was considered to be effective if no further analgesia, sedation or conversion to general anesthesia was needed.

The peri-operative pain management was comparable for most patients and primarily consisted of non-steroidal anti-inflammatory drugs, paracetamol, and opioids.

Outcomes Measures and Statistical Analysis

The analyzed variables included age, sex, weight, height, body mass index (BMI), PADSS (Post-Anesthetic Discharge Scoring System) score, and need for bladder catheterization following surgery. The outcomes considered included the time from anesthesia induction to first urination and to discharge. Pearson's correlation function was used to evaluate the correlation between the time to first urination and the patient's age and BMI.

Results

A total of 302 patients met the inclusion criteria. The mean age was 38±6.8 years; 72.3% of the examined patients were males. The age distribution of the entire cohort is shown in Figure 1, while BMI distribution is shown in Figure 2.

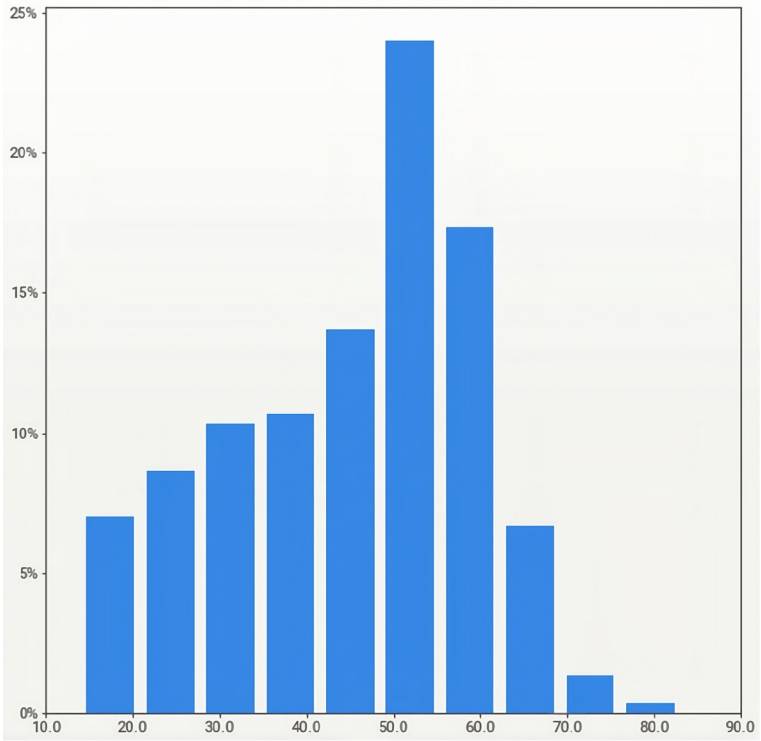

Figure 1. Age distribution of the entire sample of patients.

No complications were reported during surgery in the present series of patients. None of the patients required bladder catheterization.

In 84% of cases, the PADSS score at discharge was 10, whereas in 16% of the cases, the PADSS score was 9 (Figure 3). The mean time from anesthesia induction to first urination was 75±9.4 minutes (Figure 4), while the mean time from anesthesia induction to discharge from the hospital was 152±18.5 minutes (Figure 5).

There was no correlation between either patient's age or BMI to the time to first voiding (p = 0.6, 95% CI; p = 0.9, 95% CI, respectively).

Discussion

The present study analyzed the outcomes of the use of spinal chloroprocaine in patients undergoing minor elective knee arthroscopy in an outpatient setting. The obtained results underlined the benefits of using chloroprocaine for spinal anesthesia in the day-hospital setting, including, above all, its rapid onset and short duration of action, which allow for a fast post-surgical recovery and, consequently, more predictable discharge times[16]. In the last years, other forms of anesthesia have been proposed for short procedures such as knee arthroscopy to achieve a rapid post-operative voiding and, subsequently, discharge, including the use of local anesthesia combined with sedation[17]. Nonetheless, local anesthesia is still underestimated and considered inferior to spinal anesthesia by most surgeons, mainly because of the fear of inadequate sensory blockage[18] or possible risks of repeated procedures[19]. Therefore, since spinal anesthesia is still considered the gold standard for knee arthroscopy, the use of chloroprocaine may allow us to overcome the need to look for alternative forms of anesthesia.

The use of chloroprocaine has also been investigated in previous studies[20-23] in comparison with other local anesthetics, such as lidocaine and articaine, with favorable results in terms of recovery times after the administration. Some studies[24] have also investigated the use of bupivacaine during day-hospital procedures, which, however, was associated with a significantly higher risk of primary block failure (up to 4%) compared to chloroprocaine. Furthermore, bupivacaine has shown[25] a large heterogeneity in terms of recovery times after spinal anesthesia, to the point of sometimes preventing the discharge of patients in due time.

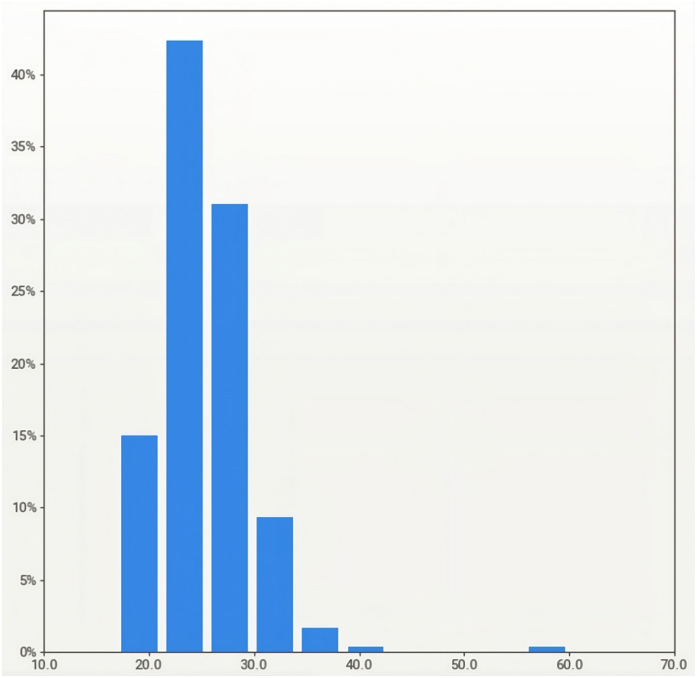

Figure 2. Body Mass Index (BMI) distribution of the included patients.

The dose of chloroprocaine that we adopted in the present study is coherent with the current literature[26,27]: in fact, for surgical procedures lasting 60 minutes or longer, previous dose-finding trials[26,27] indicated that 30 mg was often associated with insufficient analgesia, whereas 50 mg dramatically delayed the time to complete block resolution. Hence, a dose of 40 mg seemed to be ideal for achieving effective anesthesia while allowing for a timely resolution of the sensory and motor blocks[28,29]. Accordingly, it has been previously demonstrated[28,29] that a dose of 40 mg of chloroprocaine can reliably produce an anesthetic block lasting up to 60 minutes, which is, in most cases, enough to perform common arthroscopic procedures.

One of the major results obtained from our study is that none of the patients treated with chloroprocaine (more than 300) received bladder catheterization. Since spontaneous voiding is frequently a mandatory discharge criterion in the outpatient setting, this issue is particularly important from a practical standpoint, favoring the choice of this drug for minor arthroscopic procedures[4,30,31]. The large number of patients evaluated also contributes to further strengthening the reliability of this finding.

These results are also consistent with the data available in the literature[22], which confirm a higher incidence of micturition issues in patients anesthetized with lidocaine than chloroprocaine. In addition, we adopted the PADSS score in order to safely discharge the patients included in our study. This score is based on the following criteria: change <20% in vital signs from baseline (2 points), absence of dizziness

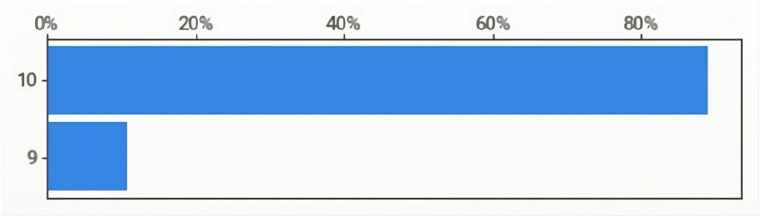

Figure 3. Post-Anesthetic Discharge Scoring System (PADSS) score of the patients included.

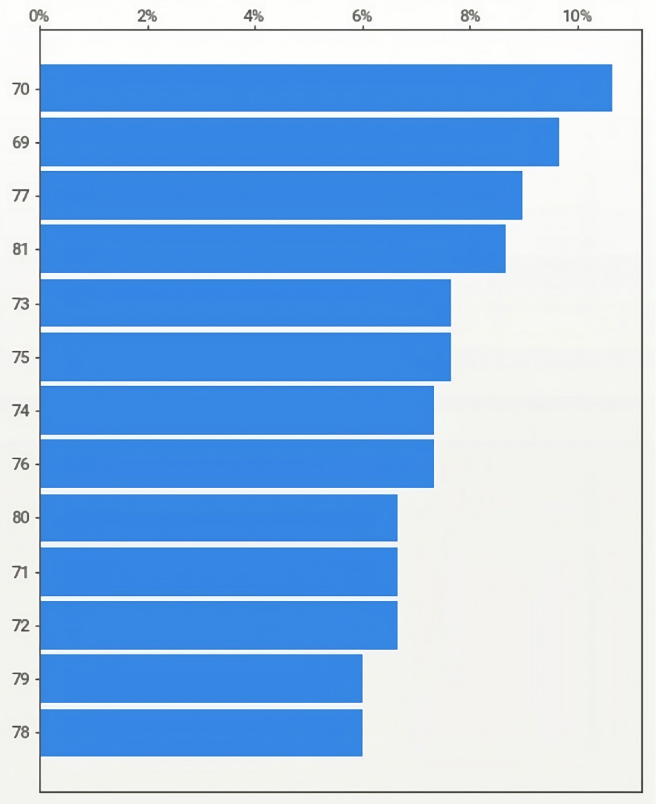

Figure 4. Time in minutes from spinal anesthesia to first voiding.

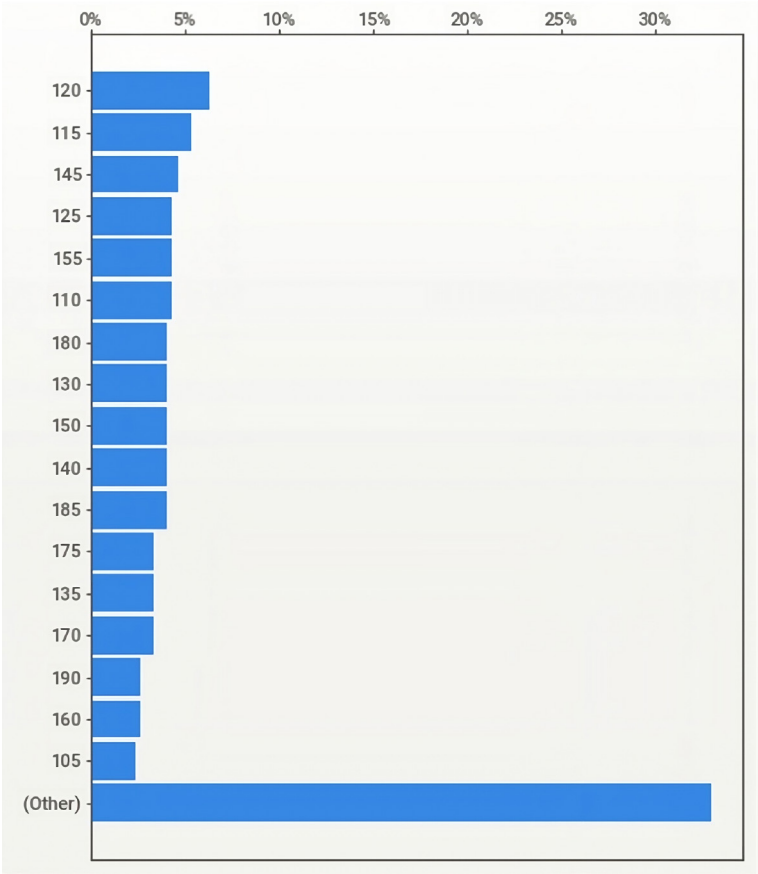

Figure 5. Time in minutes from spinal anesthesia to discharge from the hospital.

and presence of a confident gait (2 points), absence of nausea and vomiting, absence or presence of minimal pain (2 points), and absence of bleeding (2 points)[32]. All the patients included reported a score between 9 and 10 and were, therefore, safely discharged the patients on the same day of the procedure.

The decision to use chloroprocaine as a local anesthetic for orthopedic outpatient procedures should be individualized according to the patient's characteristics and, most importantly, the duration of the surgery. Indeed, considering its rapid onset and short duration of action, it may represent an optimal choice in place of the commonly used bupivacaine for patients undergoing very-fast procedures lasting up to 40 minutes, especially if young, normal-weighted, and in good physical conditions, as suggested by our patients' sample. Furthermore, the short time to first urinate and the possibility of avoiding bladder catheterization are additional factors to be considered in the fast-track setting[33], as they allow for an earlier and safer discharge of the patient. These findings underline the importance of applying a personalized approach not only in the surgical setting, but also in the anesthesiologic management of the patient, with the aim to maximize the patient's post-surgical outcome and, ultimately, satisfaction.

Limitations

Nonetheless, the present study suffers from relevant limitations: its retrospective design and the lack of a direct comparison with other commonly adopted local anesthetics for spinal anesthesia (e.g., bupivacaine).

Conclusions

Spinal chloroprocaine for knee arthroscopy demonstrated a short motor block duration, resulting in a significantly faster time to ambulation and time to discharge. The limited information that is currently available shows that chloroprocaine may be safely and effectively applied in outpatient knee arthroscopy procedures. However, more studies, possibly with a randomized design, are required to confirm these findings.

Conflict of Interest

The authors declare that they have no conflict of interests.

Acknowledgments

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Funding

None.

Informed Consent

Each patient signed an informed consent during the pre-operative visit for the use of anonymized data for scientific purposes.

Authors' Contributions

FT wrote the draft of the paper; MS coordinated the writing and critically revised the last version of the paper; GM, CB, BLP, AAA, and ADA were responsible for the collection of the data; GA, BDM, CF, and EK critically revised the paper; VS, MB, FM conducted the statistical analysis and revised the draft of the paper. All the authors gave their approval to the final version of the present manuscript.

Ethics Approval

This study was approved by the Ethics Committee of IRCCS Humanitas Research Hospital (ID: 2390/2023).

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