



Evaluating the analgesic efficacy of two anesthetic techniques during arthroscopic knee surgery

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Abstract

Background and Purpose: The aim of the study was to compare unilateral spinal and local anesthesia with respect to intraoperative and postoperative pain control, safety and complications for knee arthroscopies in outpatients.

Methods: We studied 70 ASA I or II patients scheduled for outpatient knee arthroscopic surgery. The patients were allocated into two groups to receive either local (LA group = 35) or unilateral spinal (SA group = 35) anesthesia during a year period. The LA group received portal injection (5 mL lidocaine 2% with adrenaline) and intra-articular injection into the knee (10 mL lidocaine 2% with adrenaline). The following parameters were assessed: perioperative pain (10 cm VAS: 0 = no pain, 10 = extreme pain), surgical operating conditions, patient satisfaction score (1 = very satisfied, 4 = very unsatisfied), postoperative analgesia, and time to discharge.

Results: In the LA group, 94.3% (33/35) of patients experienced no pain throughout the procedure. Only two (5.7%) patients required conversion to general anesthesia. In the unilateral SA group, one patient required conversion to general anesthesia. The need for postoperative analgesics was higher in the unilateral SA group compared with the LA group ($p < 0.01$). The mean postoperative stay was significantly shorter in the LA than the unilateral SA group ($p < 0.05$). The rate of complications differed significantly between the LA and unilateral SA groups ($p < 0.05$).

Conclusion: LA provides good pain relief following arthroscopic knee surgery compared to conventional unilateral spinal anesthesia. Major LA advantages are hemodynamic stability, patient satisfaction and faster anesthetic recovery.

INTRODUCTION

Orthopedic surgeons routinely perform arthroscopic operative procedure of the knee in an outpatient or day-stay setting rather than admit the patient to the hospital postoperatively (1–8). Advances in surgical and anesthetic techniques now permit immediate stability and mobility without compromise in safety or post-operative pain control (4, 8–10). The operation can be performed under general (GA), spinal (SA), regional or local anesthesia (LA) (5–11). Concerns about LA include fear that it will take longer to perform the surgery, that it is not useful for arthroscopic operative procedures, and that the anesthesia will be inadequate, leading to poor patient satisfaction. If the surgical

procedure is short, LA is more practical than spinal anesthesia. SA affects the cardiovascular system (11), but the mortality rate in healthy patients undergoing SA is 1:10,000 (9, 11).

We therefore (set up) carried out a prospective study to evaluate the effectiveness of two difference anesthesia techniques during surgical arthroscopy of the knee in the day surgery setting, by analyzing operative and post-operative pain control and patient satisfaction.

MATERIAL AND METHODS

Following approval by the Institutional Review Board, written informed consent and patient assent, 70 patients with the American Society of Anesthesiologists (ASA) physical status 1 or 2 were enrolled in the study.

In a prospective study, 70 patients (33 women and 37 men), mean age 27 (range 14 to 61) years, scheduled for primary elective knee arthroscopy were randomized into two groups: 35 outpatient arthroscopic procedures were done using LA with minimal intravenous sedation, whereas 35 procedures were performed under unilateral spinal anesthesia. The type of anesthesia was decided by the surgeon in agreement and after discussion with the patient. The procedures were performed from January to December 2007.

Patients were excluded from the study if they had taken analgesic or psychoactive drugs during the preceding 24 hours. In addition, patients who had undergone prior ipsilateral knee surgery or who had used NSAIDs, COX-2 inhibitors, or salicylates within 5 days of the surgery were excluded. A few patients with very painful knees, those who were considered too young or too sensitive to be able to cooperate, and those who rejected arthroscopy under local anesthetic were offered a general anesthetic.

Preoperative weight, blood pressure, and heart rate were recorded, and the patients were instructed on the use of the 10-cm visual analog scale (VAS) for pain scoring, 0 denoting »no pain« and 10 denoting »extreme pain«.

Local anesthesia: A standard three-portal (lateral, medial and suprapatellar) arthroscopic technique was used in all cases. At our institution, surgical arthroscopy of the knee under LA is performed as follows: an intravenous (IV) infusion is established, and IV sedating agent is administered to the patient. The anesthesiologist monitoring the patient throughout the procedure provides IV sedation. Sedation is individualized for each patient, as some prefer to be awake enough to watch the video monitor, whereas others prefer full sedation. Typically, 2 to 5 mg of midazolam hydrochloride (Roche) are administered IV prior to patient transfer to the operating theater. Before the administration of local anesthetic, patients receive a short-acting opioid, 5 to 10 $\mu\text{g}/\text{kg}$ of alfentanil hydrochloride IV (Janssen). Each patient requiring intraoperative redosing of sedation and analgesia is administered accordingly. If the patient experiences pain dur-

ing the procedure (VAS >3), alfentanil 0.5 mg IV is administered. Five minutes later, if the patient still has pain, an additional dose of 0.5 mg alfentanil IV is administered. No further analgesics are administered. If the patient continues to experience unacceptable pain, conversion to general anesthesia (GA) is made. Standard monitoring includes electrocardiography, blood pressure, and pulse oximetry.

The leg is prepared and draped. No tourniquet is used. The patient is warned prior to each needle stick to help reduce anxiety. LA consisting of intraarticular injection of a mixture of 2% lidocaine 10 mL with 1:200,000 epinephrine is injected into the joint cavity, and five mL of 2% lidocaine with 1:200,000 epinephrine are injected into the skin and subcutaneous tissues at each arthroscopic portal site. Care is taken to avoid infiltration of the fat pad. It is a relatively aneural structure; however, too much local infiltration causes it to balloon out into the joint during the surgery. Spread of intraarticular lidocaine is encouraged by flexion and extension of the knee joint several times and then 15 minutes allowed for anesthesia to take effect.

The arthroscope is inserted into the knee, and inflow through the sheath is established. Saline inflow is maintained through the arthroscope by the gravity system; no pump is used. Gravity outflow takes place through the superolateral portal. A separate egress cannula is used if needed. The arthroscopic examination and surgery are carried out with constant verbal communication between the surgeon and the patient. This facilitates manipulation of the leg and thorough examination of the entire joint by keeping patient anxiety and muscle tension to the minimum. The patient is encouraged to view the intraarticular problem and its treatment on the video monitor. When finished, the instruments are removed and portals are closed with a 4-0 absorbable stitch in the subcutaneous layer and steri-strips. A compression dressing is applied to the knee for three days.

Unilateral spinal anesthesia: patients were placed in the lateral position with the limb to be operated on facing downward. Spinal puncture was performed at L₂-L₃ interspace with 27G Quincke needle (B. Braun), and 7.5 mg of 0.5% hyperbaric bupivacaine (1.5 mL) were slowly injected. The patient remaining in the same posture for 20 min postinjection, then after achieving a block and checking its level the patient was placed in supine position. The spinal block degree (sensory and motor block) was assessed by pin-prick and modified Bromage score (12). If the patient was unduly anxious or still in pain, conversion to GA was made. Standard monitoring techniques were used, including electrocardiography, automated blood pressure at 5-min intervals, and pulse oximetry. After the operation, all patients were transferred directly from the operating (room) theater to the post-anesthesia care unit (PACU).

Postoperative analgesia: at PACU, vital signs, temperature, need of analgesic or antiemetic medication, and duration of recovery room stay were recorded. Additional

analgesia was given at PACU if required (VAS >3). When the patient's VAS score was more than 3 points, diclofenac was administered. In order to standardize the postoperative analgesic consumption and because postoperative analgesia is successfully managed with oral analgesics, while peripheral nerve blocks do not significantly enhance rehabilitation or functional outcome (11, 14) each study patient was supplied with a set of diclofenac (100 mg) tablets. Patients were reviewed at discharge, given standard take-home diclofenac prescriptions, and instructed to use this medication postoperatively as needed.

Postoperative stay: postoperative stay was defined as the time between transfer from the operating room to PACU and discharge. All patients were assessed 15, 30, 60 minutes, and 2 hours after surgery. VAS was used to assess pain and postoperative nausea and vomiting (PONV). For postoperative nausea or vomiting, if required, patients received metoclopramide 20 mg IV.

Patients were also asked to describe their satisfaction with the level of pain control during surgery and whether or not the patient would like to have any future arthroscopic knee procedures performed in this way (patient satisfaction score 1 = very satisfied, 4 = very unsatisfied). The surgeon was also asked if the allocated anesthesia technique was optimal and, if not, which technique he would have preferred. Intraoperative adverse events were also reported. Patients were discharged from the hospital after two hours if no side effects were recorded. Standard written instructions regarding activity, mobilization, and positioning were given to all patients.

The criteria used to determine home readiness were the following: a) vital signs within 20% of preoperative value, b) fully awake and oriented, c) able to stand up and remain standing for >1 min, d) minimal nausea and vomiting, e) minimal to moderate pain, f) minimal bleeding, and g) having had, and tolerated *per os* fluids (13). Voiding was not a requirement for determination of home readiness and was not required before discharge. Before discharge, it was recorded whether the patient was able to void.

Statistics

Median, arithmetic mean and standard deviation (SD) were calculated. Data on LA and unilateral SA were compared and statistically analyzed using Kruskal-Wallis and Wilcoxon signed-rank sum tests, and were used to test the results of VAS measurements; χ^2 -test was used to test other nonparametric data. The level of statistical significance was set at $p < 0.05$.

RESULTS

The two groups did not differ significantly according to age, weight and ASA status ($p > 0.05$) (Table 1). Both, diagnostic and therapeutic procedures were performed on an outpatient basis. The procedures performed are presented in Table 2.

TABLE 1

Patient demographic data and the American Society of Anesthesiologists (ASA) Status.

Parameter	Local anesthesia	Unilateral spinal anesthesia
Patients (n)	35	35
Men (n)	20	18
Age at surgery (yrs)	27.1 ± 6.1	27.3 ± 6.9
Women (n)	15	17
Age at surgery (yrs)	26.9 ± 7.2	27.1 ± 7.4
Weight (kg)	61.4 ± 8.21	62.1 ± 7.9
ASA 1	25	25
ASA 2	10	15

Data on age and weight are expressed as mean ± standard deviation (SD)

TABLE 2

Arthroscopic procedures.

Procedure	n
Arthroscopy	70
Arthroscopic surgery	65

A wide variety of operations were performed. The procedures performed and postoperative diagnoses are presented in Table 3, showing that similar operative procedures were performed in the two study groups. Intraoperative time interval was recorded as the time from surgical skin preparation by the surgeon until the end of the operation.

Local anesthesia: 35 patients underwent LA for outpatient knee arthroscopy. A total number of procedures were performed, yielding a mean of 1.2 procedures *per* patient. The mean operating time was 86 (range, 35 to 100) minutes, and mean arthroscopy time 25 (range, 12 to 57) minutes. The mean total anesthesia time was 95 (range, 55 to 132) minutes. The median VAS score during arthroscopy for LA patients was 2.1 (range, 0 to 10) and for the operation 2.3 (range 0 to 6.4).

In the group of 35 LA patients, 33 (94.3%) patients experienced no pain from surgical maneuvers during the procedure performed under LA with minimal intravenous sedation. Only 5.7% (2/35) of patients required conversion to GA. Three (8.5%) LA patients required additional sedating agent after 30 min and 2 (5.7%) patients needed intravenous alfentanil because of discomfort caused by the operation after 50 minutes. The patients experienced pain mostly during liquid flushing at high pressure and when attempting to see medial joint space (valgus stress).

The pain experienced during the injection of lidocaine was more severe than the pain experienced during the surgical procedure itself ($p < 0.001$). During the course of this experience, we observed that the ease of ma-

TABLE 3

Arthroscopic findings in 70 patients.

Procedure	N	Local anesthesia	Unilateral spinal anesthesia
Partial medial meniscectomy	27	14	13
Partial lateral meniscectomy	5	2	3
Bilateral meniscectomy (med.& lat.)	8	4	4
Debridement of patella and patellofemoral joint	5	2	3
Lysis of adhesions	8	3	5
Abrasion arthroplasty medial condyle	4	3	1
Abrasion arthroplasty lateral condyle	6	3	3
Abrasion arthroplasty med. & lat. condyle-degenerative changes	2	1	1
Removal of loose body	4	3	1
Synovectomy	1	0	1
Total	70	35	35

nipulating the knee depended on the level of relaxation and cooperation of the patient. No side effects such as central nervous system or cardiac symptoms due to LA (lidocaine or adrenaline) were observed.

Unilateral spinal anesthesia: 35 patients underwent unilateral SA for outpatient knee arthroscopy. A total number of procedures were performed, with a mean of 1.3 procedures *per* patient. The mean operative time was 84 (range, 26 to 146) minutes, and mean arthroscopic time 20 (range, 12 to 55) minutes. The mean time of total anesthesia was 110 (range, 57 to 192) minutes. In unilateral SA patients, the median VAS score during arthroscopy was 1.7 (range, 0 to 10) and for the operation 2.0 (range, 0 to 6.4). One patient subsequently required general endotracheal anesthesia when the spinal block was inadequate.

The evaluation of operative conditions by the surgeon (visualization and access of intra-articular structures) was generally satisfactory and completely acceptable, with no between-group differences. In 4 (5.7%) patients, LA was not considered by the surgeon to be the optimal anesthetic technique. In these 4 patients, the median VAS pain score during the surgery was 3.8 (range, 0 to 10).

Patient evaluation: in the two groups taken together, 95.4% of patients said they would have the same procedure done under the same type of anesthesia. In both groups, patients were either satisfied or very satisfied with their anesthetic. The level of satisfaction predicted whether the patient would have chosen the respective

anesthetic again, with the exception of two patients in the unilateral SA group who were only »moderately satisfied«. Also, in the unilateral SA group, 4 patients would have preferred another form of anesthesia.

Postoperative pain: differences were found between the groups in the VAS pain score during the first 2 postoperative hours at PACU (Table 4). The use of analgesics in the 0 to 2 hour interval was significantly lower in LA group ($p < 0.01$). The interval to the first analgesic requirement was significantly shorter in the unilateral SA group ($p > 0.001$). Of those using analgesics, the majority of patients used diclofenac 100 mg or less *per os* postoperatively.

The mean length of time at PACU was 75 (range, 40 to 150) minutes for LA patients and 110 (range, 50 to 210) minutes for unilateral SA patients. The difference being statistically significant ($p < 0.05$).

Adverse events

The number of complications between the LA and unilateral SA group were statistically significant ($p < 0.05$). Complications related to the use unilateral SA anesthesia ($n=6$) included: PONV ($n=3$); need of GA ($n=1$); hypotension ($n=2$).

Complications related to the use LA anesthesia ($n=2$) included: need of GA ($n=2$); effusions after arthroscopy that resolved spontaneously after using crutches for several days, so aspiration was not considered necessary. Apart from these cases, there were no other complications and no infections.

TABLE 4

Postoperative pain visual analogue scale (VAS) according to type of anesthesia.

VAS	15 min	30 min	60 min	120 min
Local anesthesia	3.3 (2.8)	3.4 (2.5)	3.2 (2.7)	3.1 (2.8)
Unilateral spinal anesthesia	3.2 (2.4)	4.4 (3.5)	4.6 (3.7)	4.1 (3.5)

All procedures were performed on an outpatient basis. None of the patients required admission for any intraoperative or postoperative complications.

DISCUSSION

Anesthesiologists often act on procedures involving just one lower limb, especially in short orthopedic surgeries (2, 3, 6–8). In our study, experience shows that adequate local anesthesia may show advantages for these lower limbs orthopedic surgery compared to conventional unilateral spinal anesthesia, which are lower incidence of PONV and hypotension, and increased patient satisfaction. This study showed that in the majority of patients (94.3%) scheduled for knee arthroscopy, both diagnostic and surgical procedures could be performed under LA with minimal sedation. The success of this protocol supports the notion that knee arthroscopy can be successfully done in the office setting, with high expectation that most pathologic problems can be treated successfully. LA alone has been used successfully by some surgeons for knee arthroscopy (12–15). Some authors have reported a high degree of success and efficiency performing arthroscopy of the knee under LA alone (16–19), or with minimal sedation (8, 9, 16). Our experience shows that LA alone is frequently insufficient to provide the patient with a comfortable operative experience. LA in combination with IV midazolam and/or alfentanil enhances patient comfort without compromising rapid recovery. Shapiro *et al.* (6) compared efficacy and safety in a series of knee arthroscopic procedures that were completed using LA, GA or regional anesthesia. They found LA with intravenous sedation to compare favorably with other techniques, a large variety of operative procedures were successfully completed and patient satisfaction remained high. Ben-David *et al.* (9) also reported that LA alone might not be fully reliable in providing a comfortable patient experience or optimal operating conditions. They showed that LA in combination with intravenous sedation may provide excellent anesthesia while still allowing for rapid recovery and patient discharge. Preoperative evaluation is essential in order to enable reduction in the number of patients in whom intraarticular pathology necessitates a switch to other forms of anesthesia. Careful selection of eligible patients and better information with respect to the potential advantages of LA might further reduce the number of patients declining LA. The patients experienced pain mostly during the liquid flushing at high pressure and when attempting to see medial joint space (valgus stress). Pain experienced during the injection of lidocaine was more severe than pain experienced during the surgical procedure itself ($p < 0.001$). Takahashi *et al.* (18) evaluated pain during arthroscopic knee surgery performed on 63 joints under LA. They found that LA provided good pain control, and that the injection of lidocaine was more severe than pain experienced during the surgical procedure itself.

Dahal *et al.* (22) reported that 20 mL of lidocaine concentrations of 1.0% or 1.5% can be instilled intraarticularly for knee arthroscopy. In the present study, the

level of patient satisfaction with LA was similar to other reports and comparable to different techniques (11–16). Our experience suggests that a single intraarticular dose of lidocaine with epinephrine provides satisfactory analgesia for arthroscopic procedures on the knee. We recommend the use of a mixture of 15 mL 2% lidocaine with epinephrine, based on patient comfort intraoperatively, and the absence of lidocaine toxicity in any of our patients.

The surgeon's evaluation of operative conditions (visualization and access of IA structures) was generally satisfactory and completely acceptable. Jacobsen *et al.* (8) showed that elective knee arthroscopy could be performed under LA in 92% of patients from the technical point of view. From the surgeon's point of view, technical problems are to be expected in 5% of patients where an alternative anesthesia method should be considered. Munk *et al.* (19) report on conversion to GA in 15%, and Sharpio *et al.* (6) in 2% of patients. Differences in the results may be due to differences in surgical and patient expectation, as well as to variation in the postoperative nursing management. Individualization is necessary, taking into account surgical technique and duration, patient preference, and institutional practice model.

In our study, intraoperative pain during unilateral spinal anesthesia was negligible and the procedure was well tolerated. As expected, complications related to the use of SA included hypotension and PONV. This technique, however, introduces other possible risks: headaches, infection (myelitis, meningitis), and prolonged back pain (12, 17).

The risks of LA are minimal. Anaphylaxis from lidocaine or bupivacaine is extremely rare. Systemic effects are extremely unusual, and numerous studies have documented low serum levels of anesthetic agents with intraarticular injection (20–22). As demonstrated in this study, there are advantages of LA beyond the reduced risk of complications. The differences in the rate of complications between the LA and SA groups were statistically significant ($p < 0.05$).

Although arthroscopy has greatly reduced perioperative morbidity and pain associated with intraarticular knee surgery, pain still does exist (8, 17, 23–24). There were differences between the groups with respect to postoperative pain. However, significantly more patients with unilateral SA used analgesics postoperatively ($p < 0.01$) compared with LA patients. Of those using analgesics, the majority of patients used diclofenac 100 mg or less *per os* postoperatively. This is surprising because the type of postoperative pain management and types of surgical procedures were similar in both groups.

CONCLUSION

According to the results of this study outpatient arthroscopy of the knee under LA with intravenous sedation is a simple, reliable and safe alternative to unilateral SA for arthroscopy procedures. Major LA advantages are high cardiocirculatory stability, patient satisfaction in remain-

ing with an unblocked limb and faster anesthetic recovery. Consequently, the standard anesthetic procedure for outpatient knee arthroscopy under lidocaine LA can be performed in many patients who wish to remain awake. We recommend the use of 2% lidocaine with epinephrine based on patient comfort intraoperatively and absence of lidocaine toxicity in our patients. Some form of intravenous sedation in minimal therapeutic dosage is recommended for optimal surgical conditions. A combination of midazolam and/or alfentanil appears to suppress the patient's perception of painful stimuli and the use of minimal therapeutic doses did not significantly prolong the patient's recovery room stay nor resulted in postoperative nausea. More prolonged postoperative analgesia also plays a role in choosing LA.

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