Randomized Trial

Dexamethasone and Dexmedetomidine as an Adjuvant to Intraarticular Bupivacaine for Postoperative Pain Relief in Knee Arthroscopic Surgery: A Randomized Trial

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Background: Knee arthroscopy causes minimal trauma, however, good analgesia is required for early rehabilitation and return to normal life in the patients.

Objective: We aimed to compare the analgesic effects of intraarticular dexamethasone and dexmedetomidine added to bupivacaine with those of bupivacaine alone.

Study Design: This study uses a double-blind, randomized, controlled design with allocation concealment in a 3-armed parallel group format among patients undergoing arthroscopic meniscal surgery.

Setting: The study was conducted at Assiut University Hospital in Asyut, Egypt. The study duration was from July 2016 to February 2017.

Methods: After the ethics committee approval, 60 patients, with the American Society of Anesthesiologists (ASA) physical status of I or II, 20 – 50 years old, and scheduled for arthroscopic meniscal surgery were randomized in a double-blind manner to receive 18mL intraarticular bupivacaine 0.25% with either dexamethasone 8 mg (group I), dexmedetomidine 1 µg/kg (group II), or 2 mL of normal saline (group III). The total volume of injectate used in each group was 20 mL. All of the patients received spinal anesthesia. Postoperatively, oral paracetamol 1000 mg was given every 8 hours, and oral tramadol 50 mg was administered, as needed, for rescue analgesia. The visual analog scale (VAS) pain scores, time to first analgesic request, and total dose of postoperative analgesics were recorded for 3 days postoperatively.

Results: The VAS scores were lower in groups I and II compared with group III. The time to the first analgesic was significantly shorter in group III compared with groups I and II (P = 0.001). The total dose of rescue paracetamol was higher in group III compared with groups I and II (P = 0.001). No need for tramadol rescue analgesia was recorded in any of the groups. No significant differences between groups I and II were noticed.

Limitations: The limitations of this study include the lack of previous research to compare the effect of both intraarticular dexamethasone and dexmedetomidine added to bupivacaine for postoperative analgesia in arthroscopic knee surgery. Additionally, there was a short observation period for the detection of chondrotoxicity, if occurred.

Conclusion: The addition of dexamethasone or dexmedetomidine to a solution of bupivacaine 0.25% provided better analgesia than using bupivacaine alone.

Clinical trial registration: NCT02818985.

Key words: Intraarticular, knee arthroscopy, bupivacaine, dexmedetomidine, dexamethasone, postoperative pain

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Knee arthroscopy is a surgical procedure that can decrease soft tissue trauma and is commonly performed on a day-case basis (1). However, knee arthroscopy is usually associated with a variable amount of pain, as the incidence of moderate-to-severe pain is about 70% following surgery (1,2).

Inadequately treated postoperative pain following knee arthroscopy results in delayed recovery, prolonged hospitalization, and increased medical care costs (2).

The use of intrathecal opioids, such as fentanyl or morphine, provides excellent postoperative analgesia but may cause side effects such as urinary retention, pruritus, nausea, and vomiting, which leads to a prolonged hospital stay (3).

Anti-inflammatory drugs can provide good analgesia in the immediate postoperative period. However, they are not site-specific and usually have side effects such as acute gastric lesions (4).

Several studies have been conducted in an attempt to find out an ideal analgesic technique that could be safe and satisfactory (1,2).

An intraarticular (IA) injection of local anesthetics and analgesics is a simple, effective, safe, and practical method that has increased in popularity (5). It is useful in decreasing patients' postoperative pain while avoiding the need for additional analgesics. Hence, it can simplify the management of the outpatient who needs complete pain control in a nonhospital setting (4).

Several studies, using different drugs and regimes, have been conducted during the last 2 decades (4,6). In the majority of these studies, IA postoperative analgesia was provided by the administration of bupivacaine (6,7). Bupivacaine is a local anaesthetic that has an immediate action on pain by blocking peripheral afferents. However, as the ideal analgesic, the drug must cover the whole postoperative period (≥ 24 hours); therefore, bupivacaine is usually combined with many adjuvants to provide long-lasting post-arthroscopy analgesia (8).

Recently, dexmedetomidine, a highly selective $\alpha 2$ adrenoceptor agonist, was used intraarticularly to augment postoperative analgesia after knee arthroscopy, demonstrating an increased time to the first analgesic request and a decreased need for postoperative analgesic drugs (9).

Dexamethasone is a potent and highly selective glucocorticoid with a minimal mineralocorticoid effect. It inhibits the nociceptive impulse transmission along the myelinated C fibers, and when combined with local anesthetics, it increases the duration of regional blocks (10).

The primary aim of this prospective, randomized, double-blind study was to evaluate the effect of adding dexamethasone versus dexmedetomidine as an adjuvant to IA bupivacaine in comparison to bupivacaine alone for postoperative analgesia in patients undergoing arthroscopic knee surgery under spinal anaesthesia.

Methods

This study protocol was approved by the local research ethics committee (the Institutional Review Board, Assiut University, Faculty of Medicine, IRB00008718, Approval Date: 27 March 2016), in accordance with the Declaration of Helsinki and was registered at ClinicalTrials.gov (NCT02818985). From July 2016 to February 2017, after obtaining written informed consent, 60 unpremedicated patients, aged 20 – 50 years (both men and women), with the American Society of Anesthesiologists physical status (ASA) I or II, and scheduled to undergo elective arthroscopic meniscectomy under spinal anaesthesia were included in this prospective, randomized, double-blind study.

Any patients with a history of cardiac, hepatic, or renal disorders as well as diabetes mellitus, hypertension, acid peptic disease, chronic pain treatment, chronic steroid therapy, contraindication to spinal anesthesia, a known allergy to the study drugs, or who refused to participate in the study were excluded.

During the preoperative visit, all of the patients were taught the use of a 10 cm visual analog scale (VAS) (with 0 = no pain and 10 = the worst imaginable pain) for postoperative pain assessment. Preoperative pain scores at rest and during movement were recorded.

In the operating room, after standard monitors were applied to the patients, including an electrocardiogram, pulse oximetry, and non-invasive blood pressure, an 18-gauge intravenous (IV) cannula was inserted, and an infusion of lactated Ringer's solution was started.

Spinal anesthesia was performed at either the L3-4 or L4-5 intervertebral space through a midline approach with a 25-gauge Quincke spinal needle with the patients in the sitting position. Once free-flow of the cerebrospinal fluid was obtained, 10 mg of 0.5% hyperbaric bupivacaine was injected. The patients were immediately placed in the supine position after completing the spinal block.

The sensory block level was evaluated by the loss of the pinprick sensation. Motor blockade was evaluated using a modified Bromage scale (0 = no motor block; 1 = inability to raise extended leg, able to bend knee;

2 = inability to bend knee, can flex ankle; and 3 = no movement) (11).

The onset of the motor block (defined as the time from the intrathecal injection of the drug until the modified Bromage scale = 3) and the duration of the motor block (defined as the time from the intrathecal injection of the drug until complete motor block recovery and the modified Bromage scale = 0) were measured (12).

Readiness to the surgery was defined as the presence of adequate motor block (Bromage's score ≥ 2) and the loss of the pinprick sensation at L1 on the operated side. The inability to reach a sensory block at L1 within 30 minutes after the spinal injection was considered to be a technical block failure and the patient was converted to general anesthesia and excluded from the subsequent analysis (3).

An orthopedic pneumatic tourniquet was situated around the mid-thigh of the operative leg and inflated to 300 mmHg until 10 minutes after the IA injection (13).

At the end of the surgery, the patients were randomly allocated into one of 3 groups (20 patients in each group) using sealed, numbered, and opaque envelopes.

Group I received an IA injection of 8mg dexamethasone added to 18mL of 0.25% bupivacaine; group II received an IA injection of 1 µg/kg dexmedetomidine added to 18 mL of 0.25% bupivacaine; group III received an IA injection of 2 mL isotonic saline added to 18 mL of 0.25% bupivacaine into the knee joint and was considered as the control group. The study solutions were prepared by an anaesthesiologist who was not involved in the study and the volume of injectate was standardized at 20 mL.

The study solution, supplied in a coded syringe, was injected once by the surgeon into the knee joint after skin closure at the end of the procedure, 10 minutes before tourniquet release, and if a drain was inserted it was closed for one hour. All of the patients were blinded to the treatment. Neither the surgeon, the anesthesiologist, the nurse following the patient postoperatively, nor those conducting follow-up surveys and data collection were aware of the randomization sequence or the content of the injected drugs.

The patients' heart rate (HR), mean arterial pressure (MAP), and VAS and sedation scores were assessed preoperatively (baseline) and then at 1, 2, 4, 6, 8, 12, 18, and 24 hours following the discharge of the patients from the operating theatre.

At each time of measurement, the pain scoring was performed at rest and during movement (90-degree flexion of the operated knee) (4).

Sedation was assessed and quantified on a 5-point scale: 0 = fully awake, 1 = somnolent, 2 = closed eyes, opens to call, 3 = closed eyes, opens to physical stimuli, and 4 = closed eyes, non-responsive to painful stimuli (14).

All of the patients were permitted to resume their normal activities as soon as possible. The time of ambulation was recorded for each group.

Oral paracetamol (1000 mg) was administered as an analgesic supplement if the recorded VAS pain score was ≥ 4 and was repeated every 8 hours, if required (3). Oral tramadol 50 mg was used as a rescue analgesic, if the patients continued to have pain 30 minutes following paracetamol administration (3,4).

The time to the first analgesic requirement (defined as the time from the IA injection of the study drug to the first requirement of rescue analgesic by the patient) (15,16) and the total paracetamol and tramadol consumption during the first 72 hours after the operation were also recorded.

The patients were also asked to verbally grade their satisfaction with the analgesia technique on a 4-point scale (1 = poor, 2 = satisfactory, 3 = good, 4 = excellent) (4) at the end of the study period.

During the patients' hospital stay, side effects such as headache, nausea, vomiting, bradycardia (defined as HR < 45 beats/min), and hypotension (defined as reduction of MAP > 25% of baseline) were treated and recorded (13).

The patients were discharged from the hospital when they were oriented to time and place, were able to void, had stable vital signs, had minimal or no pain, and could ambulate with or without the assistance of crutches (8).

At home, the patients were contacted through telephone at the end of each day for 2 consecutive days postoperatively to evaluate their pain scores, analgesic requirements, and their satisfaction with analgesia (3).

Statistical Analysis

The sample size was estimated using pain scores as the primary outcome variable. On the basis of previous studies (13,16,17) and assuming a SD of 1 cm, 17 patients were required in each group to have an 80% chance to detect a difference of 1cm on the VAS at the 5% level of significance. A sample size of 20 patients per group was then chosen to compensate for any patient drop-outs.

The Kolmogorov-Smirnov test was used for the normality of data distribution.

For nonparametric data, the Kruskal-Wallis test was used followed by the Mann-Whitney U test when a significant difference was found, and for parametric data, a one-way analysis of variance (ANOVA), followed by the post hoc test, was used.

The χ^2 test or Fisher's exact test was applied for analyzing qualitative variables as appropriate. All data are presented as means (SD) or numbers as appropriate. $P < 0.05$ was considered to be significant.

Statistical analyses were performed by computerized statistical software: SPSS, Version 21.0 (IBM Corporation, Armonk, NY).

Results

In the current study, 83 patients were examined for eligibility. Twenty-three patients were excluded: 8 for chronic pain therapy, 5 with diabetes mellitus, one with an impaired coagulation profile, and 9 for refusal to participate in the study. The recruitment was halted once the desired 60 patients were entered in the study (Fig. 1).

There were no significant differences between the 3 studied groups with respect to patient characteristics and perioperative data (Table 1).

A spinal block failure did not occur throughout the study, and the characters of sensory and motor blocks were comparable among the groups (Table 1). The MAPs and HRs were not significantly different among the studied groups.

The VAS values at baseline and in the first 4 hours after surgery were similar among the 3 studied groups at rest, whereas during movement, the VAS values at 4 hours after surgery were higher in group III compared to groups I and II ($P = 0.001$) (Fig. 2,3).

At 6 – 72 hours postoperatively, the VAS scores at rest and during movement were higher in group III than in groups I and II ($P = 0.001$) (Fig. 2,3).

There was no difference between groups I and II

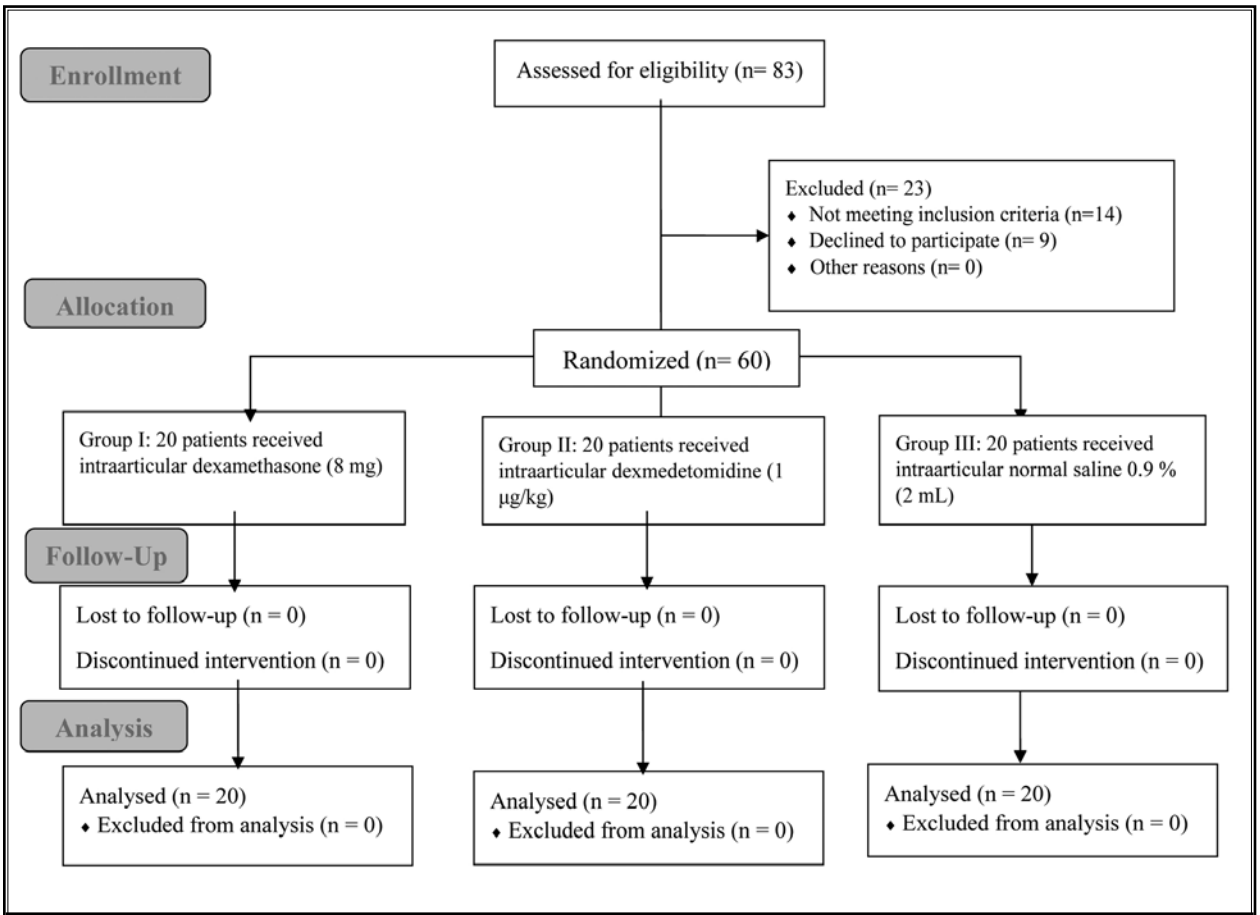

Fig. 1. *A flow diagram of the study.*

Table 1. *Patient demographics and perioperative data.*

	Group I: Dexamethasone Group (n = 20)	Group II: Dexmedetomidine Group (n = 20)	Group III: Control Group (n = 20)	*P*-value
Age (yr)	31.8 (9.40)	31.2 (8.59)	29.85 (7.94)	0.768
Weight (kg)	71.15 (5.81)	70.9 (6.47)	69.8 (5.17)	0.740
Height (cm)	169.8 (6.07)	168.95 (5.39)	170.55 (5.68)	0.678
Gender (Male/Female)	15 (75) / 5 (25)	16 (80) / 4 (20)	15 (75) / 5 (25)	0.911
ASA (I/II)	13 (65) / 7 (35)	10 (50) / 10 (50)	12 (60) / 8 (40)	0.619
Surgery Time (min)	40.55 (2.46)	39.8 (2.21)	40.75 (2.31)	0.403
Tourniquet Time (min)	55.5 (2.46)	54.8 (2.21)	55.8 (2.31)	0.375
Time to Reach Sensory Level T10 (min)	4.39 (1.01)	4.61 (1.23)	4.31 (1.31)	0.724
Time to Reach Complete Motor Block (min)	3.95 (0.99)	3.40 (1.14)	3.85 (1.18)	0.257
Time to 2 Segment Regression (min)	74.75 (6.09)	73.95 (5.27)	75.45 (5.17)	0.693
Time to the End of Spinal Anesthesia with the Start of Leg Movement (min)	175.45 (10.92)	176.30 (12.54)	172.95 (10.88)	0.633
Total Intravenous Fluid (mL)	1995 (168.5)	1950 (170.91)	1992.5 (190.76)	0.667

Data are presented as mean (SD) and number (percentage). ASA: American Society of Anesthesiologists.

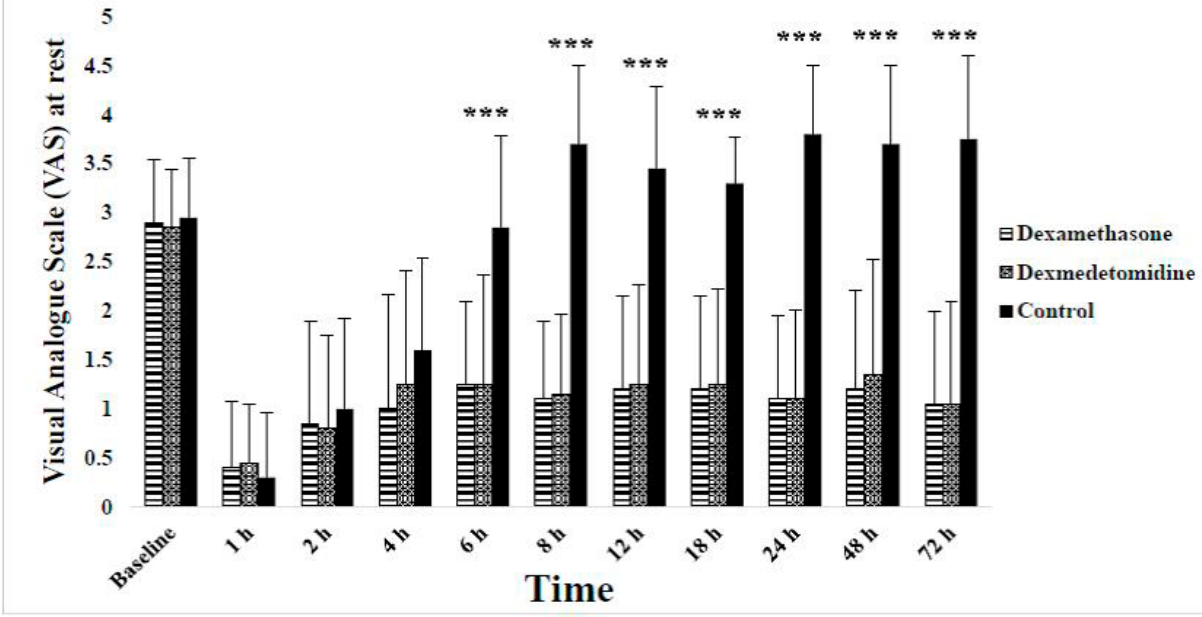

Fig. 2. *Changes in the VAS pain scores at rest; the VAS scores (mean [SD]) were measured preoperatively (baseline) and then at 1, 2, 4, 6, 8, 12, 18, 24, 48, and 72 hours after surgery.*
*** $P = 0.001$ when comparing both the dexamethasone and dexmedetomidine groups to the control group.

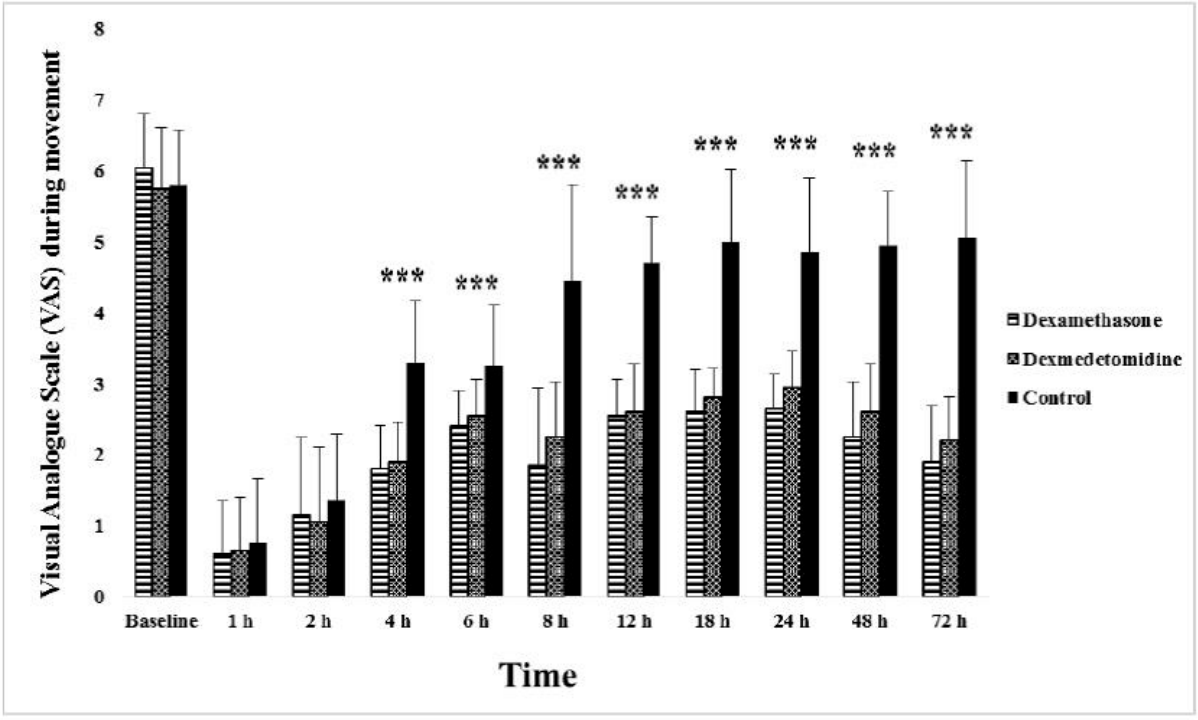

Fig. 3. *Changes in the VAS pain scores during movement; the VAS scores (mean [SD]) were measured preoperatively (baseline) and then at 1, 2, 4, 6, 8, 12, 18, 24, 48, and 72 hours after surgery.*
*** $P = 0.001$ when comparing both the dexamethasone and dexmedetomidine groups to the control group.

for VAS scores at rest and during movement throughout the study period (Fig. 2,3).

The time to the first analgesic requirement was significantly shorter in group III (mean [SD] h; 10.2 [6.101] h), whereas, none of the patients in the other 2 groups experienced pain requiring analgesia during the study period ($P = 0.001$) (Table 2).

The total dose of paracetamol tablets in the first 72 hours after operation was significantly higher in group III, while no patients in groups I and II experienced pain requiring administration of paracetamol tablets ($P = 0.001$). No need for tramadol rescue analgesia was recorded in any of the groups during the study period (Table 2).

The time to ambulation following the end of spinal anesthesia (mean [SD] min) was significantly longer in group III (241.5 [8.75] min) than in group I (119.3 [6.39] min) and group II (117.75 [5.73] min) ($P = 0.001$) (Table 2).

During the hospital stay, none of the patients in the 3 groups had experienced headache, nausea, bradycardia, or hypotension. Only the patients in group II experienced vomiting and sedation ($P = 0.01$ and $P = 0.001$, respectively) compared to groups I and III. In group II, one (5%) patient vomited twice, while 3 (15%) patients vomited once in the first postoperative day. Also, during the first postoperative hour, 6 (30%) patients had grade 1 sedation and 4 (20%) patients had grade 2 sedation.

All of the patients were successfully discharged 24 hours after surgery. No patient was readmitted. The patient satisfaction scores with analgesia at the end of the study period were higher in groups I and II than in group III (mean [SD]; 3.9 [0.308], 3.8 [0.41], and 3.1 [0.718], respectively; $P = 0.001$), while there was no difference between groups I and II (Table 2).

Discussion

In this study, we demonstrated that the use of IA dexamethasone or dexmedetomidine as an adjuvant to bupivacaine for postoperative analgesia after knee arthroscopy is effective with reduced postoperative pain and supplemental analgesic requirement in comparison to bupivacaine alone during the first 72 hours after surgery. The patients in the dexamethasone and control

Table 2. *Postoperative quality of analgesia, time for ambulation, and patient satisfaction.*

	Group I: Dexamethasone Group (n = 20)	Group II: Dexmedetomidine Group (n = 20)	Group III: Control Group (n = 20)	*P*-value
Patients Requiring Rescue Analgesia (Paracetamol) During the First 24 h Postoperatively	0 (0)	0 (0)	17 (85)	0.001
Time to First Analgesic Request (h)	0 (0)	0 (0)	10.2 (6.101)	0.001
Total Dose of Paracetamol (No. of Tablets/72 h)	0 (0)	0 (0)	15.3 (1.49)	0.001
Patients Requiring Tramadol	0 (0)	0 (0)	0 (0)	
Time to Ambulation After the End of Spinal Anesthesia (min)	119.3 (6.39)	117.75 (5.73)	241.5 (8.75)	0.001
Patient Satisfaction	3.9 (0.308)	3.8 (0.41)	3.1 (0.718)	0.001

Data are presented as number (percentage) and mean (SD). $P < 0.05$ was considered statistically significant when comparing both the dexamethasone and dexmedetomidine groups to the control group.

groups experienced less adverse effects.

Arthroscopic knee surgery is performed as an outpatient procedure, and effective, simple postoperative analgesia is important for early rehabilitation and return to daily activities of life.

Many agents have been injected intraarticularly either alone or in combination to provide effective postoperative analgesia. These agents include local anesthetics such as lidocaine and bupivacaine, opioids such as morphine, and alpha2 adrenoceptor agonists such as clonidine, dexmedetomidine, and magnesium sulphate (10,18).

IA bupivacaine is the commonly preferred local anesthetic with or without adjuvant for pain relief after arthroscopic surgery (15). However, local anesthetic agents can produce analgesia for a limited time when used as single injection (10). In our trial, we compared the analgesic effect of IA bupivacaine alone and combined with either dexamethasone or dexmedetomidine in patients undergoing arthroscopic knee surgery.

IA dexmedetomidine has been used alone or as an adjuvant to local anesthetics for effective postoperative pain relief. Several studies have reported that IA dexmedetomidine 1 μg/kg as an adjuvant to local anesthetics augments postoperative analgesia and reduces the need of analgesics after arthroscopic knee surgery (18-20).

Dexmedetomidine is an alpha2 adrenoceptor agonist that provides analgesia through supraspinal, spinal, and peripheral actions. IA dexmedetomidine is thought to perform its analgesic effect mainly through its direct local action, however, a central effect due to systemic absorption cannot be excluded (18,20).

IA dexmedetomidine, similar to IA clonidine, may provide local anesthetic action that blocks the conduction of nerve signals through C and Aδ fibers, analgesic action through modulation of the opioid analgesic pathway, and may stimulate the release of enkephalin-like substances at peripheral sites (18).

In a study by Tarlika et al (15), patients who received IA ropivacaine (0.25%) (19 mL) with dexmedetomidine (1 μg/kg) (1 mL), total volume 20 mL, at the end of arthroscopy were pain free for (mean [SD] h; 11.42 [1.25] h) and were sedated but easily arousable. Only 2 patients (8%) experienced hypotension which was treated with IV fluids, while none of the patients experienced nausea, vomiting, bradycardia, or respiratory depression. Similarly, Paul et al (18) found the time to the first analgesic request following IA dexmedetomidine in combination with ropivacaine after arthroscopic knee surgery was 10.84 ± 2.6 h.

In Alipour et al's (9) study, IA dexmedetomidine alone in patients undergoing knee arthroscopy provided analgesia for (mean [SD] h; 21.97 [6.30] h). Additionally, Al-Metwalli et al (13) reported that the time to the first postoperative analgesic request was (mean [SD] min; 312 [120.7] min) in patients who received IA dexmedetomidine (1 μg/kg).

In their routine practice, Panigrahi et al (17) observed that the patients felt comfortable until the spinal anesthesia wore off (2 – 3 hours), then they experienced pain which limited their cooperation with their postoperative rehabilitation protocols. However, the usage of IA analgesics provides postoperative analgesia up to 10 hours, enabling patients to remain pain free and tolerate rehabilitation better.

In our study, the patients who received IA bupivacaine/dexmedetomidine were pain free during the study period. Ten patients were sedated in the first postoperative hour, 4 patients had vomiting, while no patient experienced bradycardia or hypotension.

IA glucocorticoid has been used previously to improve pain relief after meniscectomy and synovitis (21). Dexamethasone, a 9α-derivative synthetic glucocorticoid that has highly potent anti-inflammatory action with minimal mineralocorticoid activity, can inhibit prostaglandin synthesis and increase the release of endorphins, thus it is safer and free of many potential side effects (10). Additionally, it prolongs the action of local anesthetics when used together, while significantly prolonging the duration of analgesia in extremity nerve blocks (22).

A limited number of studies have investigated the analgesic effect of IA dexamethasone after arthroscopic knee surgery (10,23-25).

Bhattacharjee et al (10) concluded that the addition of 8 mg (2 mL) of dexamethasone to 18 mL of 0.25% levobupivacaine IA, a total volume of 20 mL, in patients undergoing arthroscopic knee surgery prolonged the duration of postoperative analgesia for 10.24 ± 2.8 hours. Similarly, Heshmati et al (23) have studied 60 ASA I patients scheduled for meniscectomy under general anesthesia. The patients were randomly assigned to receive either 10mL bupivacaine 0.5% with epinephrine 1:200000, 8 mL bupivacaine 0.5% with epinephrine 1:200000 plus 2 mL (8 mg) dexamethasone, or 10 mL of normal saline. They evaluated the patients until 12 hours postoperatively and the VAS scores were measured at rest. They found during the first 6 hours after surgery that the VAS scores were significantly lower in both the IA dexamethasone plus bupivacaine and bupivacaine alone groups (versus the control group), but after 6 hours, the patients in the dexamethasone group had significantly lower pain and swelling than the other groups. The authors did not report any adverse events and all of the patients were discharged from the hospital the day after surgery.

In their prospective, randomized, double-blinded study, Panigrahi et al (24) investigated the effect of an IA injection of 0.2% ropivacaine alone and combined with high-dose dexamethasone 300 µg/kg and 1 µg/kg dexmedetomidine following knee arthroscopic surgery (total volume 20 mL). They reported the lowest pain scores with the longest time to the first analgesic request (mean [SD] min; 1356.2 [193.10] min) in the ropivacaine/dexamethasone group compared to the ropivacaine/dexmedetomidine group (433.2 [54.3] min) and the ropivacaine group (311.8 [61.56] min. No clinical incidence of nausea, vomiting, sedation, bradycardia, hypotension, or other side events requiring intervention was recorded in their patients. The authors attributed their results to the usage of high-dose dexamethasone.

In the current study, the patients in the dexamethasone group were pain free during the whole study period. This intense and prolonged analgesia in the dexamethasone group may be attributed to dexamethasone's synergistic effect with the local anesthetic due to the local action via steroid receptors, not a systemic one. Steroids might produce this effect by altering the function of potassium channels in excitable cells (10,25).

In contrast to the previous results, Saryazd et al (26) found that patients who received IA dexamethasone 8 mg in 10 mL isotonic saline at the end of knee arthroscopic meniscectomy during general anesthesia did not decrease post-arthroscopic pain with greater analgesic requirement in the first postoperative day and had a significantly longer time to gain the ability to walk, about 42.7 hours postoperatively. However, the results of the study by Saryazd et al could be explained by the fact that steroids, when used alone in regional blocks, do not produce blockade (10). In our study, the patients who received IA dexamethasone or dexmedetomidine combined with bupivacaine were pain free throughout the study period and started to walk earlier than the patients who received IA bupivacaine alone.

Finally, the prolonged analgesia achieved in both the dexamethasone and dexmedetomidine groups in our study may be attributed to the type of arthroscopic surgery performed, as meniscal surgery is associated with less pain intensity (17,27).

The current study was limited initially by the lack of previous researches comparing the effect of both IA dexamethasone and dexmedetomidine added to bupivacaine for postoperative analgesia in arthroscopic knee surgery. Also, there was a short postoperative follow-up period; therefore we were unable to draw the occurrence of infection or the chondrotoxicity of IA bupivacaine. However, a recent meta-analysis has found the chondrotoxic effects of bupivacaine in vitro as well as in vivo to be dose-dependent, suggesting that low-dose IA bupivacaine is potentially the least harmful (28). This meta-analysis has reported that "given equal efficacy for pain control after arthroscopic knee surgery across doses and a dose-response relationship for chondrotoxic effects, a clinical decision leaning toward low-dose (50 mg) bupivacaine appears to be

supported, although the lowest effective bupivacaine dose has not yet been identified (28)." In our study, we used IA bupivacaine in a low dose of 45 mg in order to avoid the occurrence of chondrotoxicity. However, we recommend additional randomized controlled trials with larger sample sizes and longer follow-up periods to examine the safety and efficacy of single administration IA bupivacaine alone or combined with either dexamethasone or dexmedetomidine at different concentrations, doses, and with epinephrine use.

Conclusion

In conclusion, dexamethasone and dexmedetomidine, when administered intraarticularly as an adjuvant to local anesthetic bupivacaine, enhance the quality and duration of postoperative analgesia and decreases postoperative analgesics consumption in patients undergoing elective knee arthroscopy.

Author Contributions

S.M.M. was responsible for the study's design, data analysis, writing the draft of the paper, and editing and preparing the final manuscript. I.K.R. and H.A.E. were also responsible for the design of the study, data analysis, and writing the draft of the paper.

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