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Comparison of efficacy of intraarticular application of tenoxicam, bupivacaine and tenoxicam: bupivacaine combination in arthroscopic knee surgery

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Abstract Arthroscopic knee surgery is one of the most common surgeries done in outpatient settings; however, postoperative pain is believed to be the major barrier for discharge and early rehabilitation. In this study we evaluated and compared the efficacy of intraarticular application of long-lasting non-steroidal analgesic drug tenoxicam, a long-lasting local anaesthetic bupivacaine and combination of the two on postoperative pain after arthroscopic knee surgery. With the approval of the local ethics committee and signed informed consent of the patients, 75 American Society of Anesthesiologists I–II patients aged between 18 and 65 years going under elective arthroscopic meniscectomy were included in this randomized, blind, prospective study. The patients were divided into three groups: group-T (GT) patients (n=25) had intraarticular 20 mg of tenoxicam in 20 ml normal saline; group-B (GB) patients (n=25) had 50 mg bupivacaine in 20 ml normal saline (0.25%); group-BT (GBT) patients (n=25) had intraarticular 20 mg of tenoxicam and 50 mg bupivacaine (0.25%) in 20 ml normal saline after completion of the surgery and before deflation of the tourniquet. Postoperative analgesia was maintained by intravenous tramadol hydrochloride 50 mg/s at the first 4 h and paracetamol 500 mg and codeine 7.5 mg preparation (Pacofen) as needed (maximum six per day) during the study period. The numeric rating scale (NRS) values were at rest and at active–passive motion at 4, 12, 24 and 48 h, total analgesic consumption, at 4 h for tramadol and at the end of 48 h for oral medication; and patient satisfaction at the end of 48 h was evaluated and recorded. The demographic features of the patients, and tourniquet times, were found to be similar between the groups. Group BT had significantly lower NRS values than GB at 12 h at rest. Group BT was found to have significantly lower NRS values at 4 h compared with GT, and significantly lower NRS values at 12 h compared with GB. Group BT was found to have significantly lower NRS values at 48 h compared with GB. Group T had significantly higher NRS values at 4 h compared with GB. Group B had significantly higher values at 12 h compared with GT and GBT. Group B used significantly more analgesics than GBT and GT throughout the study period. Group BT patients had significantly more satisfaction at the end of the study period when compared with GT and GB. Application of intraarticular tenoxicam–bupivacaine solution is a simple, safe and effective method of analgesia after arthroscopic meniscectomy with high patient satisfaction.

Keywords Arthroscopy · Postoperative analgesia · Postoperative pain · Tenoxicam · Bupivacaine

Introduction

Improvements in the anaesthetic, analgesic and surgical techniques, evolution of short-acting drugs and common use of regional anaesthetic/analgesic techniques, allow more cases to become outpatient surgery.

Arthroscopic knee surgery is one of the most common surgical procedures done in outpatient settings; however, postoperative pain is believed to be the major barrier for discharge and early rehabilitation. A variety of analgesic techniques, such as systemic drug medication, central blockades, peripheral blockades, pre-emptive analgesia and intraarticular drug administration, have been tried to prevent or treat pain due to arthroscopic knee surgery [6, 15, 16]. Some of the techniques require expensive equipment and monitoring, some produce inadequate analgesia and some involve the risk of discharge delay or recurrent admission.

Satisfactory analgesia has been provided by intraarticular bupivacaine; however, the analgesic effect does not last long. Much research has been done to prolong analgesia such as supplementing with ketamine, clonidine, morphine or nonsteroidal analgesics [5, 8, 17]. Nonsteroidal analgesics are found to be effective in improving analgesia after arthroscopic knee surgery, but the optimal route is still speculative [3, 4].

In this study we evaluated and compared the efficacy of intraarticular application of a long-lasting nonsteroidal analgesic drug, tenoxicam, a long-lasting local anaesthetic bupivacaine and combination of the two on postoperative analgesia after arthroscopic knee surgery.

Patients and methods

Study design: randomised, blind, prospective study

With the approval of the local ethics committee and signed informed consent of the patients, 75 American Society of Anesthesiologists (ASA) I–II patients aged between 18 and 65 years undergoing elective arthroscopic meniscectomy for symptomatic isolated irreparable tears were included in the study. The decision of inclusion in the study and the randomization were done just after the surgery and before the injection in order to standardize the surgical procedure performed in the patients. All patients were evaluated with respect to their systemic problems prior to inclusion in the study. The inclusion criteria are summarized in Table 1.

Table 1 The inclusion criteria

Age between 18–65 years
American Society of Anesthesiologists I–II
Signed informed consent
Non-pregnant
No analgesic consumption for the previous 7 days
No allergies to anaesthetics, opioids or NSAIDs
No pain >4 due to knee pathology
Tourniquet time 30–60 min
No other intraarticular lesion

All patients were given an explanation about pain evaluation with numeric rating scale (NRS) and patient satisfaction rated as poor, moderate, good or excellent, and instructions for active–passive motion (isometric quadriceps exercises and flexion–extension beyond 90°), before the surgery.

The patients were divided into three groups randomly with random numbers.

Anaesthetic technique

All patients had 0.01 mg/kg intravenous midazolam as premedication. The vital parameters were: non-invasive arterial blood pressures (NIBP); peripheral oxygen saturation values (SpO2); and heart rates (HR) were monitored by Horizon XL during the surgery and for 4 h postoperatively. The patients had 2 mg/kg propofol (Diprivan), 1 μ/kg fentanyl and 0.2 mg/kg atracurium during induction and laryngeal masks (no. 3/4) were placed. The anaesthesia was maintained with 40% O2, 60% N2O, 1–2% sevoflurane and no supplemental opioids were used during anaesthesia.

Pneumatic tourniquet between 250 and 300 mmHg pressure was applied to all patients after induction and before surgery.

Groups

Group T (GT: tenoxicam administered) patients (n=25) had intraarticular 20 mg of tenoxicam in 20 ml normal saline, group B (GB: bupivacaine administered) patients (n=25) had 50 mg bupivacaine in 20 ml normal saline (0.25%) and group BT (GBT: tenoxicam+bupivacaine administered) patients (n=25) had intraarticular 20 mg of tenoxicam and 50 mg bupivacaine (0.25%) in 20 ml normal saline.

All the surgical procedures and intraarticular injections were performed by the same orthopaedic surgeon. The injections were performed through the same and main arthroscopic portal after completion of the surgical procedure and irrigation and before application of the dressing and deflation of the tourniquet.

Postoperative analgesia

Postoperative analgesia was maintained by intravenous 50 mg tramadol hydrochloride (THCL, Contramal) when NRS values were >4 at the first 4 h during hospital stay and paracetamol 500 mg and codeine 7.5 mg preparation (Pacofen) as needed (maximum six per day) during the study period (48 h).

Evaluation parameters

The numeric rating scale (NRS) was used, where 0=no pain and 10=worst pain imaginable. Values at rest and at active–passive motion at 4, 12, 24 and 48 h, amount of total analgesic consumption for tramadol hydrochloride (THCL) at the fourth postoperative hour, amount of total oral analgesic (codeine+paracetamol) consumption at the end of 48 h, and patient satisfaction (rated as poor=0, moderate=1, good=2, excellent=3) at the end of 48 h were requested and recorded by a senior anaesthesiology resident who was blinded to the solution administered.

Statistical evaluation

Descriptive tables and statistical analyses were made with SPSS 7.5 (SAS Institute, Cary, N.C.) statistical program for Windows. The age and tourniquet time were calculated by Student's t-test between the groups. Gender distribution of the patients, and number of patients demanding analgesics during the first 4 postoperative hours, were calculated by chi-square test between the groups.

Table 2 The age, gender distribution and tourniquet time of the groups (p>0.05, NS)

	GB	GT	GBT	Significance
Age range (years, ±SD)	18–34 (22.9±4.0)	18–41 (23.1±5.4)	18–36 (21.6±4.0)	NS
M/F	21/4	23/2	20/5	NS
Tourniquet time (min, ±SD)	30–55 (42.7±7.8)	34–56 (42.4±6.8)	30–60 (45.0±9.2)	NS

The NRS values, number of analgesics consumed, and patient satisfaction values were evaluated by Kruskal-Wallis non-parametric test between the groups. The comparisons within the groups were made with Friedmann non-parametric test. Post-hoc tests for Friedmann and Kruskal-Wallis tests were made with Graphed Instat version 2.02. A level of p=0.05 was considered as statistically significant.

Results

The demographic features (age, gender) of the patients and tourniquet times were found to be similar between the groups (Table 2).

NRS: rest

When the groups were evaluated on their NRS values, GBT had significantly lower NRS values (p<0.05) than GB at 12 h at rest. There was no other significant difference between the groups at other times (Fig. 1).

Group T had significantly higher values at 4 h compared with 48 h (p<0.05). Group B had significantly higher values at12 h compared with 48 h (p<0.05).

Active motion

Group BT was found to have significantly lower NRS values at 4 h compared with GT, and significantly lower NRS values at 12 h compared with GB. Again GBT was found to have significantly lower NRS values at 48 h compared with GB (Fig. 2).

Group T had significantly lower values at 48 h compared with 4-h values. Group BT was found to have significantly higher NRS values at 24 h compared with 12-h values.

Group B had significantly higher values at 12 and 48 h compared with 4-h values (p<0.05).

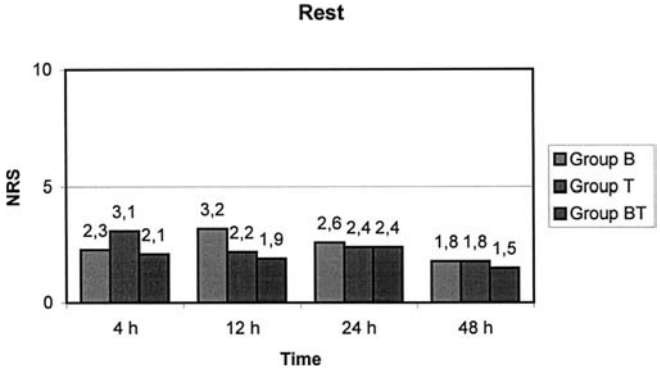

Fig. 1 The comparison of numeric rating scale (NRS) values of the groups at rest (12 h: GB–GBT; p<0.05)

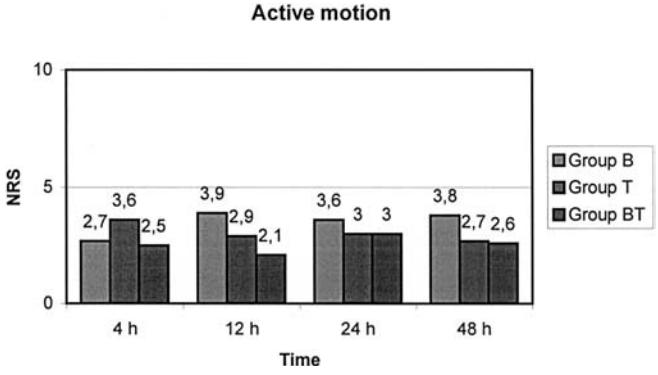

Fig. 2 The comparison of NRS values of the groups at active motion (4 h: GT–GBT, p<0.05; 12 h: GB–GBT, p<0.05; 48 h: GB–GBT, p<0.05)

Passive motion

Group T had significantly higher NRS values at 4 h compared with GBT (p<0.05). Group B had significantly higher values at 12 h compared with GT and GBT (p<0.05, p<0.05; Fig. 3).

There were no significant differences between the groups at passive motion between the controls.

Analgesic consumption

Seven patients from GB used intravenous tramadol hydrochloride which was significantly less than in GT (Table 3) in the first postoperative 4 h.

Group B used significantly more analgesics than GBT and GT (p<0.05, p<0.05; Fig. 4; Table 2) throughout the study period.

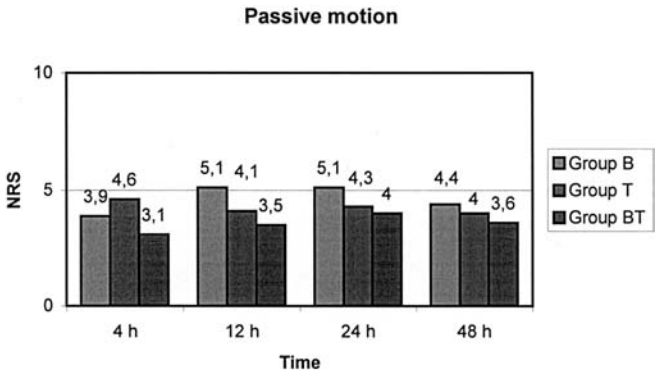

Fig. 3 The comparison of NRS values of the groups at passive movement (4 h: GT–GBT, $p<0.05$; 12 h: GB–GT, $p<0.05$)

Table 3 The number of patients using tramadol hydrochloride (THCL) in the study groups at the first 4 postoperative hours (chi-square test; GB–-GT, $df=1$, $p<0.05$)

	Group B	Group T	Group BT
THCL+	7	16	11
THCL-	18	9	14

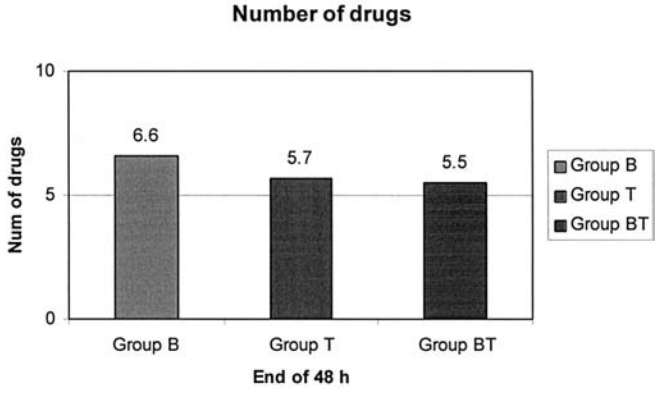

Fig. 4 Evaluation of the number of drugs consumed by the patients of the study groups (GB–GBT, $p<0.05$; GB–GT, $p<0.05$)

Three patients from GT, 2 patients from GBT and 2 patients from GB had nausea and vomiting during the first 4 postoperative hours. No other side effects or complications were observed either due to the anaesthetic, analgesic methods used or the drugs consumed during the study period.

Patient satisfaction

Group BT patients had significantly more satisfaction at the end of the study period when compared with GT and GB patients (Fig. 5).

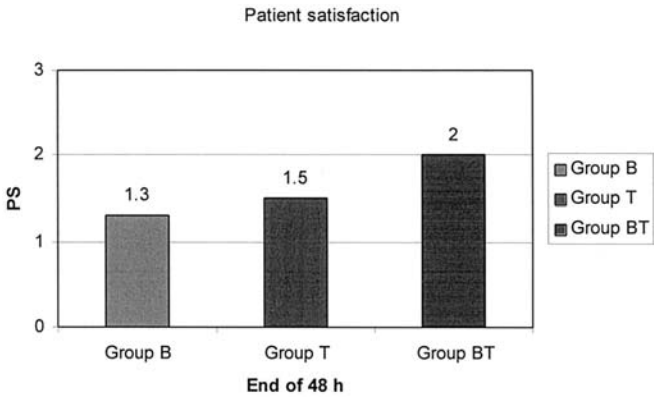

Fig. 5 Evaluation of patient satisfaction (*PS*) of the patients of the study groups (GB–GBT, $p<0.05$)

Discussion

In order to decrease the costs, many procedures, such as diagnostic and therapeutic arthroscopy, are now being performed on an ambulatory basis [12, 15]; however, postoperative pain is sometimes a disabling problem after arthroscopic knee surgery which can be a limiting factor for discharge from the hospital, and recovery from surgery. Effective pain management not only shortens hospital stay but also improves recovery from knee surgery and contributes to early rehabilitation.

Many treatment modalities, such as central neural blockades, peripheral blockades, pre-emptive analgesia and intraarticular administration of drugs, have been applied for postoperative pain relief after arthroscopic knee surgery, but none of them have yet been identified to be the ideal method. In fact, intraarticular drug administration is one of the simplest techniques requiring no specialized equipment for pain management after arthroscopic knee surgery. Local anaesthetic and opioid drugs, such as morphine, lidocaine, bupivacaine, clonidine and NSAIDs, are the most commonly used intraarticular drugs [1, 2, 16]; however, there are not many studies on the topic which are controlled and blinded, and many minor details of these studies vary leading to inconsistent results [3, 13, 16].

In our study we evaluated the efficacy of intraarticular application of tenoxicam, bupivacaine and combination of the two on postoperative pain, and patient satisfaction after arthroscopic meniscectomy. By evaluating the results obtained from our study we can propose that bupivacaine and tenoxicam together provide satisfactory analgesia and high patient satisfaction after arthroscopic meniscectomy. In fact, local anaesthetics have been found to be effective in reducing postoperative pain in arthroscopic knee surgery [1, 6, 9, 18]; however, they are short lived and addition to opioids are sometimes effective and sometimes not [3]. Although bupivacaine-administered groups (GB and

GBT) in our study had lower NRS values with lower tramadol hydrochloride consumption at the first 4 h at rest and active–passive motion, as the efficacy of local anaesthetic diminished the patients' NRS values in only bupivacaine administered group (GB) increased and the same group used more analgesics than the other two groups at the end of the study period. In a similar clinical trial, Khoury et al. [10] obtained better analgesia in the patients treated with bupivacaine and morphine combination than only morphine-administered patients throughout their study period.

Since the pain after arthroscopic surgery may be due to the site of reconstruction, patellar tendon graft and inflammation, oedema and the hyperalgesic substances produced [5, 13, 20], antiinflammatory agents, such as nonsteroidal drugs (NSAIDs) and steroids, either applied systemically or locally, may help to reduce inflammation and swelling, which may occur, and reduce pain and consequent analgesic consumption. Wang et al. [20] reported a study on postoperative efficacy of intraarticular triamcinolone application. They had better results in triamcinolone group when compared with control group. In our study we chose a nonsteroid agent tenoxicam, which is a long-acting (49–81 h; T1/2=67 h) [11] agent, with fewer side effects to add to bupivacaine in order to prolong analgesia and increase patient satisfaction. Tenoxicam was found to be a suitable agent for intraarticular injection since it does not suppress chondro-formative processes [3]. Application of intraarticular tenoxicam was found to be effective by Cook et al. [3] in a clinical trial as well. Using both a local anaesthetic and a long-acting NSAID brings the advantage of the additive synergic effect between the analgesic drugs [13].

Since it was planned that the patients were to be ambulatory as soon as they were discharged from the hospital, the pain evaluation was planned to be done not only at rest but also upon active–passive motion in our study. This is in fact essential to evaluate absolute pain relief since all the groups had similar NRS values at rest except at the twelfth hour, but the values had significant changes during active and passive motion. In addition, as the patients were planned to be ambulatory after discharge from the hospital, their pain during activity and their disability due to pain directly affected their satisfaction. Consequently, the analgesia is not only important for comfort but also for early recovery.

The bupivacaine–tenoxicam group (GBT) had better pain relief during active motion, and GBT had significantly lower NRS values compared with GB at the 12 and 48 h; during passive movement GBT had significantly lower visual analogue scale values compared with GT the fourth hour and GB at the twelfth hour. Group BT had lower doses of analgesics at the end of the study period, so these patients were able to start rehabilitation program and return to their daily activities much sooner. This also contributed to better patient satisfaction and to the success of the surgery.

In the early postoperative period bupivacaine-administered groups (GB and GBT) had fewer patients demanding tramadol hydrochloride; however, this was significant only in the GB with 7 patients compared with GT with 16 patients. This is because tenoxicam is a slow but long-acting agent and in the first 4 h it does not reach its therapeutic concentration. This explanation is confirmed by the fact that in both groups with bupivacaine, the analgesic consumption at the first 4 h was lower than in the tenoxicam group.

By evaluating the results obtained from our study we propose that bupivacaine and tenoxicam together provide satisfactory analgesia and high patient satisfaction after arthroscopic meniscectomy. Another important aspect of our study when compared with the others is that the patients' age range (18–41 years) was younger and narrower; and secondly, the pathology and the type of surgical procedure were similar. Thus, the study groups were uniform which we believe was useful to prevent any possible non-detected degenerative lesion that may cause pain rather than surgery itself or uncontrollable variables due to different surgical procedures. As a result, intraarticular administration of a combination of bupivacaine and the long-acting nonsteroidal agent tenoxicam provides good analgesia at rest, and during active–passive motion in the early and late postoperative period leading to a higher degree of patient satisfaction postoperatively in patients undergoing elective arthroscopic meniscectomy.

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