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ORIGINAL STUDY

Comparison of regional nerve block to epidural anaesthesia in day care arthroscopic surgery of the knee

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Day care minimally invasive surgery demands minimal complications with anaesthesia. Nerve blocks are increasingly being employed for surgical procedures on the lower limb, and we attempted to evaluate their benefits and drawbacks in a prospective randomised study in patients undergoing knee arthroscopy. We compared the effectiveness, onset time, duration of analgesia, patient acceptance, failure rate and post-operative comfort of epidural anaesthesia (with 20 ml of 2% lidocaine with adrenaline 1 in 200000) and peripheral nerve blocks (combined 3-in-1 and sciatic nerve block, with 50 ml of 1% lignocaine with adrenaline 1 in 200000, using nerve stimulator). Forty nine cases were randomised to receive either single shot epidural anaesthesia (Group-I, n = 23) or combined 3-in-1 and sciatic nerve block (Group-II, n = 26).

The anaesthesia procedure and analgesia onset time was longer in Group-II ($p < 0.001$), with skin incision being significantly delayed as compared to group-I (45.2 ± 6.2min vs 30.0 ± 5.4 min respectively) ($p < 0.001$). Haemodynamic changes were comparable in both groups during the study period. All patients had complete analgesia at skin incision in group-I as compared to 89.1% in group-II ($p < 0.05$). However 52.2% of patients in group-I required rescue analgesia postoperatively, as compared to only 18.7% in group-II ($p < 0.05$).

We concluded that even though combined 3-in-1 and sciatic nerve block technique has longer anaesthesia induction time, the lesser need for postoperative rescue analgesia, and lesser potential complications like inadvertent spinal puncture, retention of urine and late onset of back pain, make this an attractive option for day care arthroscopy. The use of a nerve stimulator ensures accuracy, patient counselling allows good cooperation, and advance planning can include potential skin incision delays.

INTRODUCTION

Arthroscopy is a minimally invasive orthopaedic technique, which has few complications, substantially shorter hospital stay, and quicker functional recovery after surgery. It is often performed on healthy patients with benign knee pathology as an outpatient procedure. These surgical advances must go hand in hand with appropriate day care anaesthetic techniques, if their benefits are to be realized to the maximum (*7*).

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Various anaesthetic techniques used for arthroscopy range from general anaesthesia, central neuraxial block, to local anaesthesia including regional nerve block techniques. General anaesthesia offers the advantage of obviating the time limits and ensuring perioperative comforts both for surgeon and patient, but needs longer hospitalisation than the orthopaedic pathology itself would require ; it is also associated with increased incidence of nausea and vomiting (*7*), sore throat and increased postoperative analgesic requirement (*20*). Central-neuraxial anaesthesia whether subarachnoid or epidural has the advantage of being a straightforward, quick and reliable technique. The disadvantages of these techniques are mainly in their contraindications such as patient refusal, clotting disorders, skin infections and sepsis ; and their side effects such as urinary retention, low back pain and post dural puncture headache, all of which delay patient discharge (*6*).

Local anaesthesia with intra-articular irrigation, consisting of local infiltration of entry sites plus continuous perfusion to irrigate the joint with local anaesthetic may provide sufficient analgesia. However, it may not be well tolerated in certain arthroscopic procedures where joint manipulation and tourniquet are required (*2*). As a result of the above-mentioned drawbacks, an effort has been made to use multiple nerve blocks offering the requisite anaesthetic effectiveness with minimal contraindications, and maximum efficacy.

The latter option is becoming increasingly more attractive, bearing in mind the minimally invasive characteristics of surgery performed. Very few reports exist in the orthopaedic literature about nerve blocks for arthroscopy, which potentially have few side effects ; these reportedly allow early discharge, and have high patient satisfaction, and provide satisfactory operating conditions.

Although some studies (*6, 8, 12, 17*) have evaluated and compared efficacy of nerve blocks for knee arthroscopy, there is little mention in the literature about knee arthroscopy being done under tourniquet using combined 3-in-1 and sciatic nerve blocks. As this has substantial potential benefits, we decided to prospectively compare onset and recovery profiles of patients undergoing similar arthroscopic knee surgery under epidural anaesthesia with those done with nerve blocks.

MATERIALS AND METHODS

After Institutional Ethical Committee approval and written informed consent from the patients, this prospective randomised study was conducted on 50 healthy ASA (American Society of Anaesthesiologists) class-I & II patients scheduled for knee arthroscopy as a day care procedure. Exclusion criteria included a history of peripheral neuropathy, bleeding disorder, use of anticoagulants and patient refusal. Anatomical abnormality in spine was an exclusion criterion for epidural anaesthesia and inability to identify anatomical landmarks was an exclusion criterion for performing nerve block. Patients requiring anterior cruciate ligament (ACL) or other ligamentous reconstruction were excluded from the study, as they were not day care patients and an extra articular procedure like graft harvesting was also needed.

All patients were given similar premedication (0.15-0.2 mg/kg body weight diazepam orally on the night before surgery). Eight hours fasting prior to surgery was ensured in all cases. Patients were randomised to receive either epidural or nerve block by using random number charts. The same anaesthetist performed all the blocks.

Group-I (Epidural) : Under aseptic precautions, these patients were given single shot epidural anaesthesia with 20 ml of 2% lignocaine with 1 in 200,000 adrenaline through 18G Tuohy needle inserted in the L3-4 interspace. The epidural space was identified by loss of resistance and proper position of the needle was further confirmed using a test dose of 3 ml of 2% lignocaine with 1:200,000 (15 mg) adrenaline, given before the administration of the drug solution, to rule out inadvertent subarachnoid or intravenous administration.

Group-II (Nerve block) : The patients included in this group were given combined 3-in-1 (femoral, obturator and lateral cutaneous nerve of thigh) and sciatic nerve blocks using 50 ml of 1% lignocaine with 1 in 200,000 adrenaline. Of the 50 ml, 30 ml was used for the 3-in-1 block, and 20ml for the sciatic nerve block after negative aspiration to rule out intravascular administration. Both blocks were performed in supine position under aseptic precautions, with the aid of a nerve stimulator (Microstim plus). This nerve stimulator is capable of delivering a single twitch that can be adjusted from 1 to10 mA.

First the sciatic nerve block was performed in the supine position with the hip joint flexed as described by

Raj *et al* (14) (posterior approach) followed by 3-in-1 block as described by Winnie *et al* (19).

Ten minutes after performing the respective anaesthetic procedure in both groups, temperature and pinprick sensation were checked around the knee joint for the onset of analgesia at five-minute intervals till loss of sensation was demonstrated. Thereafter, a tourniquet was applied following exsanguination of the limb at the level of the thigh to all the patients in both groups, and incision was given. All the arthroscopic surgeries were performed by one surgeon and operative conditions were subjectively evaluated by him.

Fentanyl (2 µg/kg body weight) was given intravenously if patients were uncomfortable on skin incision. If the patient still remained uncomfortable during the arthroscopic procedure, general anaesthesia was planned to be given and the case would be excluded from this study, after evaluating cause for procedural failure. Monitoring included ECG, HR, NIBP and SpO_2. Recording of monitored parameters was done every 5 minutes intraoperatively and every 30 minutes in the recovery room postoperatively, till the patients were discharged. The other parameters recorded were : (a) Time taken for anaesthetic procedure, (b) time taken for onset of analgesia, (c) duration of surgical procedure, (d) duration of postoperative analgesia, and (e) severity of pain by a ten point linear visual analogue score (VAS). The rating of VAS was as follows : '0' as no pain and "10" as maximum imaginable pain (2). Postoperatively rescue analgesia was given with diclofenac sodium 1.5 mg/kg body weight intramuscularly, if the visual analogue score was more than 4 or whenever patients made demand for it. Nausea was also measured using a 10-point numerical VAS with '0' as no nausea and "10" as nausea as bad as could be. A score of greater than 5 was considered severe, a score of 5 as moderate, less than 5 as minimal (2). Vomiting was evaluated by the number of episodes of vomiting. Rescue anti-emetic ondonsetron 0.1 mg/kg body weight was given I.V slowly if more than two episodes of vomiting occurred. For the purpose of data collection, retching (same as vomiting without expulsion of gastric contents) was considered equivalent to vomiting. An episode of vomiting was defined as events of vomiting that occurred in a rapid sequence (less than 1 minute between events) (15). If events of vomiting were separated by greater than one minute, they were considered as separate episodes. Incidences of nausea, vomiting, shivering, delay in discharge, number of patients requiring rescue analgesia, rescue anti-emetic and general anaesthesia were noted in both groups. Patients were considered fit for discharge if they were able to walk, pass urine, retain fluids orally and were pain free (6). Discharge times in both the groups were also noted. Patient satisfaction was rated on a verbal scale of 5 = very satisfied, 4 = satisfied, 3 = neutral, 2 = unsatisfied, 1 = very unsatisfied (2). This was recorded at the time of discharge. Patients were also enquired about their opinion regarding use of same technique again if they had to undergo a similar procedure in the future.

Statistical Analysis

The sample sizes in this study were small (Group-I = 23, Group-II = 26), and were not normally distributed. Therefore non-parametric tests were used for all analyses. Differences with respect to demographic data (age, weight, sex distribution and duration of arthroscopy) between the two groups were analysed using Mann-Whitney U test. Mean duration of analgesia was analysed by log rank statistics. Differences in time taken for anaesthetic procedure, time taken for onset of analgesia, duration of postoperative analgesia, incidences of nausea, vomiting and shivering were analysed by using the Kruskal- Wallis test. P value less than 0.05 was considered as statistically significant.

RESULTS

Out of fifty patients initially included in this study, one patient in the epidural group had accidental high spinal anaesthesia and was excluded from analysis. None of the remaining patients in either group required general anaesthesia for failed epidural or nerve block. Hence, there were 49 patients in this study out of which 23 received epidural block and 26 received nerve block.

As shown in table I, both groups were comparable in their demographic data ($p > 0.05$). The mean duration of arthroscopy was comparable in both groups (29.6 ± 8.9 min in group-I vs 31.5 ± 8.7 min in group-II, $p > 0.05$). Types of arthroscopic surgical procedures done in both groups are shown in table II ; this distribution was comparable in both groups ($p > 0.05$).

Anaesthesia procedure and analgesia onset time was longer in Group-II than in Group-I ($p < 0.001$). Hence, total anaesthesia time required before skin incision was significantly longer in group-II as compared to group-I (45.2 ± 6.2 min vs 30.0 ± 5.4 min respectively) ($p < 0.001$) (table III).

Table-I . — Demographic data (Mean ± SD)

	Group-I (n = (20)3)	Group-II (n = (20)6)
Age (yrs)	3(20).0 ± 10.3	(20)9.6 ± 9.8
Weight (Kg)	60.0 ± 5.3	58.1 ± 5.(20)
Male / Female	(20)0/3	(20)3/3
Duration of arthroscopy (Min)	(20)9.6 ± 8.9	31.5 ± 8.3

$p > 0.05$.

Table-II. — Distribution of arthroscopic procedures

	Group-I (n = (20)3)	Group-II (n = (20)6)
Medial meniscectomy	9	11
Lateral meniscectomy	4	6
Loose body removal	4	5
Chondroplasty	3	(20)
Synovectomy	3	(20)

$p > 0.05$.

All patients in both groups were able to use VAS to express the severity of theirpain. All patients were comfortable at the start of arthroscopy in group-I with a median VAS score of 0 (0-0) as compared to 21 (80.8%) for the patients in group-II with median VAS 0 (0-4) ($p < 0.0001$). The remaining five patients in this group had mild discomfort in the beginning and responded to intravenous fentanyl.

Haemodynamic parameters (HR, SBP, DBP, MAP) and SpO_2 were comparable within the group and between the groups during the intra and postoperative period. Operative conditions were similar in both groups as per the operating surgeon.

Log rank statistics revealed significant difference in the postoperative pain free interval between epidural and nerve block groups as shown in fig 1 by Kaplan-Meier survival graph. Only 4 (17.4%) patients in group-I were completely pain free with

Table-III. — Pre-incision data (Mean ± SD)

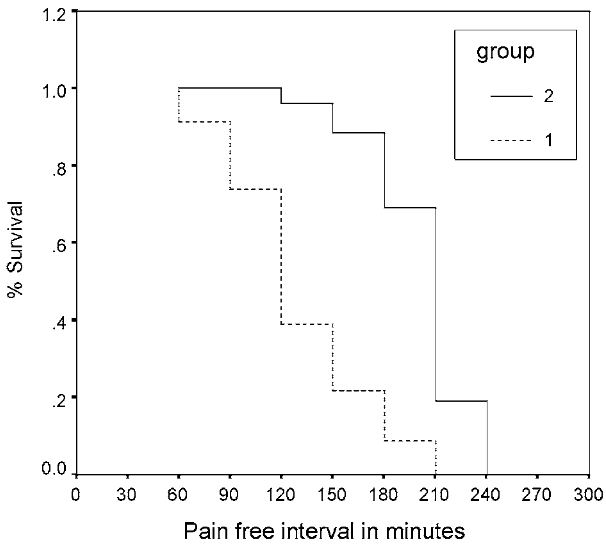
	Group-I (n = (20)3)	Group-II (n = (20)6)
Procedure time (min)	15.(20) ± 3.(20)	(20)(20).5± 5.7*
Analgesia onset time (Min)	14.7 ±3.8	(20)(20).3 ± 4.7*
Total anaesthesia time (Min)	30.0 ± 5.4	45.(20) ± 6.(20)*
Pain at the time of skin incision (No. of patients)	0	5 (19.(20)%)*

* $p < 0.05$.

Table IV. — Postoperative data

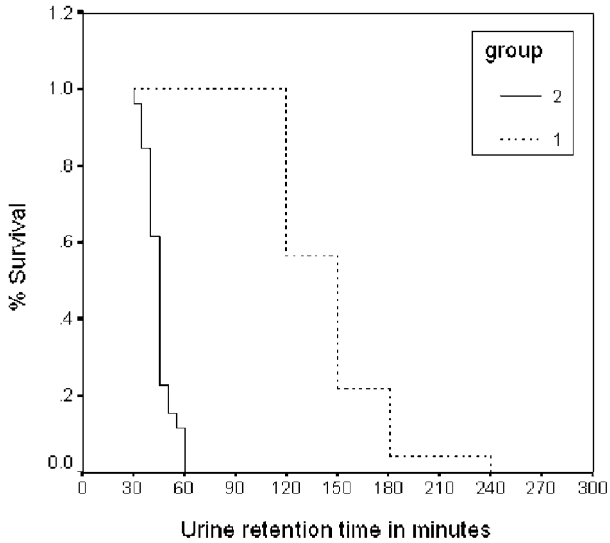
	Group-I (n = (20)3)	Group-II (n = (20)6)	p value
Urinary retention time in minutes (Mean ± SD)	146.9 ± 30.4	77.3 ± 19.3	p < 0.015*
Motor block regression time in minutes (Mean ± SD)	96.5 ± 18.0	180.0 ± (20)(20).5	p < 0.0001*
Mean duration of analgesia in minutes (Mean ± SD)	130.4 ± 4(20).0	(20)03.1 ± (20)9.8	p < 0.0001*
Discharge time in minutes (Mean ± SD)	(20)06.9 ± 33.0	(20)(20)1.5 ± 19.(20)	p > 0.057
Total time spent in hospital in minutes (Mean ± SD)	(20)50.4 ± (20)8.7	(20)68.5 ± (20)(20).7	p < 0.0001*
Rescue analgesic requirement Number of patients (%)	1(20)(5(20)%)	0	p < 0.0001*
Incidence of shivering Number of patients (%)	10(43%)	0	p < 0.0001*

*$p < 0.05$



p < 0.05 between the groups

Fig. 1. — Kaplan-Meier survival graph for postoperative pain free interval between epidural and nerve block group.



p < 0.05 between the groups

Fig. 2. — Kaplan-Meier survival graph for postoperative urine retention time between epidural and nerve block group.

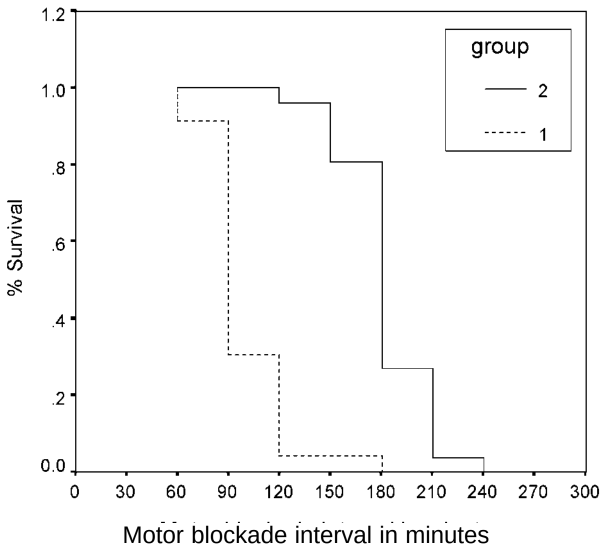
a median VAS score of 0(0-0) as compared to 19 (73.1%) for the patients in group-II during postoperative observation period till discharge ($p < 0.001$). Postoperative mean duration of analgesia was shorter (130.4 ± 42.0 min) in group-I as compared to group-II (203.1 ± 29.8 min) ($p < 0.001$). In group-I, 12 (52.2%) of the patients required rescue analgesia as compared to none in group-II before discharge ($p < 0.001$).

The time interval after which patients were able to pass urine was significantly prolonged in group-I as compared to group II after shifting to recovery room (146.9 ± 30.4 vs 77.3 ± 19.3 min respectively) ($p < 0.015$) (fig 2). Motor block resolution (Bromage scale > 4/6) occurred earlier in Group-I as compared to Group-II (96.5 ± 18.0 min vs 180.0 ± 22.5 min respectively) ($p < 0.001$) (fig 3). Despite early recovery of motor block in group-I, postoperative discharge times were comparable in both groups. In group-I, discharge time was 207.0 ± 33.0 minutes and in group-II it was 221.5 ± 19.2 minutes after shifting to recovery room. ($p > 0.05$) (fig 4). However, total time spent in the hospital (anaesthesia time + surgery time + discharge time) was shorter in group-I as compared to group-II (250.4 ± 28.7 min vs 268.5 ± 22.7 min respectively) ($p < 0.001$).

In both groups none of the patients complained of nausea or vomiting during the postoperative observation period before discharge. Shivering was reported in 10 (43.5%) patients in group-I only.

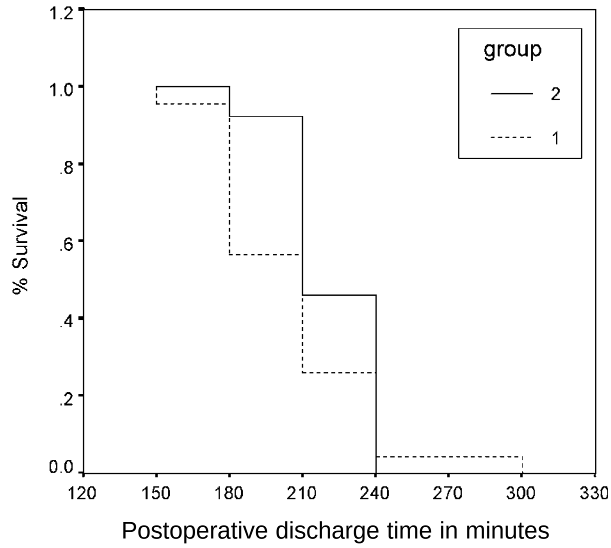
Overall level of satisfaction with the anaesthetic procedure was lower in group-I than group-II. Twelve (52.2%) patients in group-I and 22 (84.6%) patients in group-II were either very satisfied or satisfied with the anaesthetic technique (fig 4) ($p < 0.05$). One patient in each group was not comfortable with the anaesthetic technique. The remaining patients (fig 5) in both groups were neutral.

Thirteen (56.2%) patients in group-I and 21 (80.8%) patients in group-II showed their willingness to have the same anaesthetic technique if they had to undergo arthroscopy in the future ($p < 0.05$). Eight patients (34.8%) in group-I and 4 patients (15.4%) in group-II said that they could not comment about the procedure. One patient in both groups would not like to choose the same anaesthetic technique if he was offered a new technique. These differences were statistically not significant ($p > 0.05$) (fig 6).



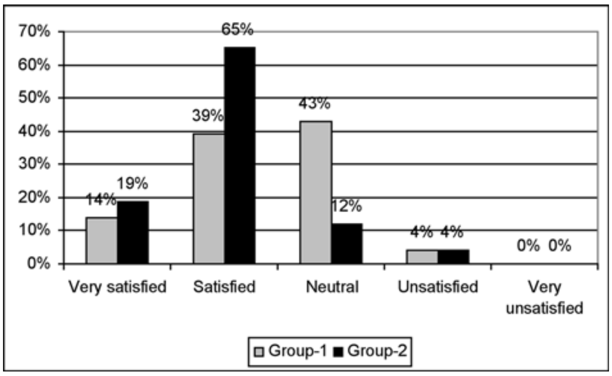
p < 0.05 between the groups

Fig. 3. — Kaplan - Meier Survival graph for postoperative motor blockade time between epidural and nerve block group.



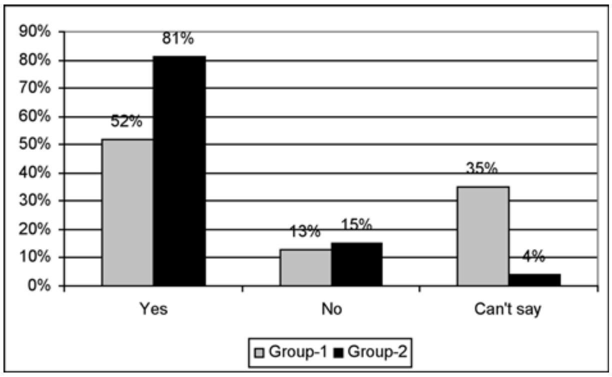
p < 0.05 between the groups

Fig. 4. — Kaplan - Meier Survival graph for postoperative discharge time between epidural and nerve block group.



p < 0.05 between the groups

Fig. 5. — Patients' satisfaction with anaesthesia technique in both groups.



p < 0.05 between the groups

Fig. 6. — Patients' preference of same anaesthetic technique in the future.

DISCUSSION

In day care anaesthetic procedures like knee arthroscopy, several issues are considered such as safety, procedure time, early ambulation, postoperative analgesia and cost effectiveness (*20*). Even though general anaesthesia continues to be the anaesthetic technique preferred by most of the patients for short procedures (*16*), there is some evidence that mortality and morbidity are higher for general anaesthesia than for blocks, especially for lower abdominal and lower limb surgeries (*13*). Spinal and epidural blocks are relatively simple techniques, however, the risk of complications such as headache, infection, urinary retention, and cardio-circulatory instability are significantly limiting their use in outpatient surgery. Moreover, they are contraindicated in patients with anatomical abnormalities of spine, bleeding disorders and in unwilling patients. Nerve blocks can be useful in such scenarios.

In the present study we compared single shot epidural with nerve blocks for outpatient arthroscopy and found that the time to perform epidural block was shorter than that needed to perform nerve blocks. A study conducted by Dahl *et al* (*7*) in which spinal, epidural, and general anaesthesia techniques for arthroscopy were compared, reported longer procedural time for epidural block as compared to our study. This disparity is because of epidural catheter insertion in their study as opposed to our study where the drug was given as a single shot.

The increased time required to perform the nerve blocks as compared to epidurals in this study can be explained by the need for performing two blocks i.e. sciatic and 3-in-1 block that required preparation and localisation of two anatomic sites. Casati *et al* (*5*) reported a lesser time required to perform sciatic and femoral nerve blocks, using multiple injection technique with the aid of a nerve stimulator, as compared to our study. This is because we performed 3-in-1 block, which requires tourniquet inflation for five minutes for proximal spread of local anaesthetic solution. However, they found that performing nerve blocks took a longer time than general anaesthesia.

In this study, analgesia onset time was longer in the nerve block group than in the epidural block group. This can be explained by the fact that local anaesthetic has to reach up to the nerve fibres from the site of injection, which is kept a little away from the vicinity of the nerve to avoid injury to the nerve (*11*). Moreover, local anaesthetic solution has to cross different anatomical barriers such as fibrous tissue and nerve sheath before reaching the site of action in peripheral nerves. In case of epidural block rapid diffusion of local anaesthetic towards the thin dural cuff region causes faster onset of analgesia (*4*).

Analgesia onset time for nerve blocks was shorter in the study conducted by Casati *et al* (6) than in our study, as they used multiple injection technique that enhances drug spread and decreases analgesia onset time. In our study we did not use multiple injection technique, as we thought it would be unacceptable to our patients. Analgesia onset times in our study are comparable with the study conducted by Sansone *et al* (*17*) in which single injection technique was used to perform nerve blocks.

The femoral nerve under the inguinal ligament no longer consists of a single common trunk but has already divided into four main branches (*3*). The classical technique of identifying the nerve by paraesthesia usually localises only one of the nerve branches, and the local anaesthetic may not reach all components of the nerve trunk. Using paraesthesia technique, the sciatic nerve can also be identified at its extreme periphery ; however there is the consequent risk of nerve injury and local anaesthetic may not completely surround the nerve, leading to block failure (*1*). Magora *et al* (*9*) found that the use of a nerve stimulator increases the success rate of peripheral nerve blocks more reliably than blind anatomic approach or fluoroscopy. We thus performed all the blocks by use of a nerve stimulator without eliciting paraesthesia, to avoid failure.

Knee arthroscopy had been performed under combined sciatic and femoral nerve blocks by Sansone *et al* (*17*). However, in their study additional sedation and analgesia was required in 20% and 12% respectively and 0.7% of patients required general anaesthesia to complete arthroscopy. The knee joint is innervated by three nerves : 1) the femoral nerve, through its branches to the vasti, especially the vastus medialis. 2) the sciatic nerve, through the genicular branches of the tibial and common peroneal nerve, and 3) the obturator nerve, through its posterior division. Hence, blockade of these nerves is required for surgery at or around the knee joint (3). In addition, if a tourniquet is applied, it is essential to block the lateral cutaneous nerve of the thigh to increase the tolerance to tourniquet pain (*12*). The sciatic and 3-in-1 blocks used for arthroscopy in this study gave 100% success, without the need of supplementing with general anaesthesia in any case of the nerve block group. Five patients (19.2%) in the nerve block group, however, required intravenous fentanyl at the time of incision, probably because of partial initial blockade ; this progressed to complete blockade with passage of time, as they did not require further sedation or analgesics.

Voluntary micturition was earlier in the nerve block group than in the epidural group, as there was inhibition of bladder sensation and presacral parasympathetic outflow in the latter. Urinary retention is an undesirable complication, delaying patient discharge, requiring intervention at times, and raising patient apprehension levels, and is associated with epidural anaesthesia ; this has also been reported in a study conducted by Mulroy *et al* (*10*).

Block regression occurred earlier in the epidural than in the nerve block group. Regression of block occurs due to diffusion of the local anaesthetic away from the site of action that in turn depends upon the vascularity of that particular tissue (*18*). Rapid washout of the drug from the epidural space due to greater vascularity resulted in earlier block regression than in the nerve block group in this study. Early epidural block regression is consistent with studies conducted by Dahl *et al* (*7*) and Casati *et al* (*6*) in which epidural block was compared with nerve blocks and spinal anaesthesia respectively for outpatient arthroscopy. However, both these studies reported earlier time to discharge in the epidural group as compared to our study. This may be due to the fact that they used chlorprocaine and plain lignocaine for epidural block, i.e. shorter acting local anaesthetics, as compared to lignocaine with adrenaline used in our study.

Despite early block regression in the epidural group, discharge times were comparable with the nerve block group in our study. This was due to : 1) Retention of urine, 2) increased need for postoperative analgesia and, 3) need for observation of patients till rescue analgesic was effective. Discharge times in our study were comparable with the study conducted by Dahl *et al* (*7*).

In spite of similar discharge times, the total time spent in hospital was longer in the nerve block group in this study due to the long anaesthesia time that included procedural time and analgesia onset time.

Increased visual analogue scores for pain, shorter duration of analgesia and more incidence of rescue analgesic requirement during postoperative observational period in the epidural block group as compared to nerve block group can be attributed to early block regression. In our study rescue analgesic requirement in the epidural group was high as compared to studies conducted by Dahl *et al* (*7*) and Mulroy *et al* (*10*). This can be explained by the fact that Mulroy *et al* (*10*) injected bupivacaine and Dahl *et al* (*7*) injected intra-articular morphine at the end of arthroscopy. Rescue analgesia requirements in the nerve block group in our study were similar to the study conducted by Casati *et al* (*6*).

Intraoperative shivering was seen only in the epidural group. This was probably due to stimulation of thermo-receptors present in the epidural space by the cold drug at room temperature.

Satisfaction rates were high in the nerve block group. In spite of thorough counselling, fear of backache in the future and urinary retention were the main reasons for dissatisfaction in the epidural group. Patients who were not satisfied with nerve block reported that they felt discomfort because of repeated needle pricks and occurrence of unintentional paraesthesia while performing the sciatic block.

Patient satisfaction in the nerve block group was higher in our study than in a similar study conducted by Sansone *et al* (*17*), although neither group of patients required any rescue analgesia This is because we performed combined sciatic and 3-in-1 block, which provided more effective analgesia for arthroscopy under tourniquet use, than combined sciatic and femoral nerve block performed by Sansone *et al* in their study (*17*).

One drawback of our study was that it was not possible to blind the observer to the anaesthesia technique as he became aware about the type of block performed in the immediate postoperative period by the unilateral or bilateral nature of motor weakness in the lower limbs.

The results of this study conclude that even though it takes longer time to perform the combined 3-in-1 and sciatic nerve blocks, they provide high satisfaction scores and postoperative analgesia in patients undergoing knee arthroscopic surgical interventions on a day care basis. These nerve blocks can be a suitable alternative in view of patient interest, especially when systemic illness or local conditions preclude use of general anaesthesia and central neuraxial blocks.

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