STUDY OF ULTRASOUND-GUIDED CONTINUOUS FEMORAL NERVE BLOCKADE WITH EPIDURAL ANALGESIA FOR PAIN RELIEF AFTER TOTAL KNEE REPLACEMENT

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ABSTRACT

BACKGROUND

Total knee replacement causes moderate-to-severe pain requiring effective analgesia. With use of ultrasound guidance, we may prove a more suitable approach compared with the epidural technique.

Aim of this study is the comparison between Continuous Epidural Analgesia (CEA) and Continuous Femoral Block (CFB) techniques in Total Knee Replacement surgeries.

MATERIALS AND METHODS

This study was conducted on 60 adult male and female patients undergoing total knee replacement surgery for a period of 2 years. Patients were divided into 2 groups. Group - 1: Continuous epidural analgesia patients, Group - 2: Continuous femoral blockage patients. All patients were assessed clinically preoperatively and investigated to rule out any systemic disease.

RESULTS

The mean age of patient in Group - 1 was 66.54 ± 4.98 and in Group - 2 was 66.98 ± 5.02 years. P value was > 0.05, which was not significant. No significant differences in gender is observed between the groups. VAS scores were significantly high (P < 0.05) in the femoral group at 6 h, after which there was a declining trend and scores were essentially similar from 24 h. The use of rescue analgesic was also higher in the femoral group. Analysis of side-effects showed that all the five common side-effects were twice as common in the epidural group than in the femoral study group. Only one patient in the femoral group had urinary retention when compared with four in the epidural group. The differences were not statistically significant. Muscle power at 48 h, time getting out of the bed and time stay in hospital (days) are significant in comparison in 2 groups, range of movement is insignificant in groups. Patient satisfaction score was measured on a scale of 1 - 10. Patients in the Femoral group were slightly more satisfied with a mean ± SD score of 8.1 ± 1.2 when compared with the epidural group 7.3 ± 1.01.

CONCLUSION

Continuous femoral blockade using US guidance provides equivalent analgesia with a lower incidence of common side-effects when compared with continuous epidural analgesia.

KEYWORDS

Ultrasound, Continuous Femoral Blockade, Continuous Epidural Analgesia.

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BACKGROUND

Knee replacements have emerged as a mainstream surgery. That number is expected to grow into the millions by the year 2030. Relatively few complications happen during the hospital stay after a Total Knee Replacement (TKR). A surgeon may use general or regional anaesthesia to put you into a deep sleep or numb your leg. Effective postoperative pain control is important, especially with the initiation of physiotherapy and early ambulation, which hastens recovery and reduces hospital length of stay.[1] Pain control modalities for post-TKA include intravenous Patient-Controlled Analgesia (PCA), peripheral nerve blockade and continuous epidural analgesic techniques. All methods have been shown to be efficacious in relieving postoperative pain. However, conventional techniques that use intravenous PCA with morphine and fentanyl are associated with side effects such as respiratory depression, sedation, pruritus, nausea and vomiting, hypotension, constipation and urinary retention.[2,3]

Regional analgesia is widely used for Total Knee Replacement surgeries (TKR), as it has lesser side-effects and better analgesic efficacy when compared with traditional oral analgesics. Peripheral nerve blockade has also been utilised including continuous infusion techniques. With the use of ultrasound, the needle and catheter placement can be done accurately under real-time guidance.[4] Ultrasound-guided needle and catheter placement is observed to be

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technically superior with much accurate needle placement. Being placed at peripheral locations probably increases the safety latitude of these techniques compared with the epidural technique. Although, seemingly effective with comparatively less risk, there are not many head-to-head studies to compare the two techniques.[5] In the following study, we compared the use of continuous epidural analgesia against continuous femoral blockage for effective and safe post-operative analgesia for TKR patients in a randomised, non-blinded, two-arm parallel study.

MATERIALS AND METHODS

This study was conducted on 60 adult male and female patients undergoing Total Knee Replacement surgery. Patients were selected who have approached for surgery for a period of 2 years from January 2013 to 2015 in Chalmeda Anand Rao Medical College.

Inclusion Criteria

All patients undergoing total knee replacement surgeries, ASA Grade 1 and 2 patients and patients giving valid informed consent.

Exclusion Criteria

Patients belonging to ASA Grade 3 and Grade 4, history of respiratory problems, angina, palpitations, syncope, coronary artery disease, ECG abnormalities, hepatic, coagulopathy, renal problems, moderate-to-severe diabetic or other neuropathies, allergy to LA or other medications, pre-existing severe pain conditions necessitating other analgesics, patients having bilateral TKR and patient refusal. After approval by the Institutional Ethical Committee, pre-anaesthetic check-up was carried out pre-operatively with a detailed history, general physical examination and systemic examination. Airway assessment and spinal column examinations were done.

The following laboratory examinations were done in all the subjects in study – Haemoglobin, Urine analysis, Blood sugar, Blood urea, Serum creatinine, Coagulation profile, Blood grouping and Rh typing, ECG - for patients over 40 years of age and chest x-ray.

All patients were assessed clinically preoperatively and investigated to rule out any systemic disease. After informed consent, patients were divided into 2 groups.

Group - 1: Continuous epidural analgesia patients

Group - 2: Continuous femoral blockage patients

All patients in the Group - 1 had an epidural catheter inserted before spinal anaesthesia or general anaesthesia (GA); whereas in the Group 2 all femoral catheters were inserted after the surgery to lessen any impact on the operating list with the availability of only one ultrasound machine.

Epidural catheters were inserted through the L3-L4 interspace with loss of resistance to air technique using an 18-G epidural catheter set. Catheters were advanced until 4 cm within the epidural space.

In cases having GA, femoral catheters were inserted and a bolus of Local Anaesthetic (LA) mixture injected before extubation. In patients having spinal anaesthesia, femoral catheters were inserted and a similar bolus of LA mixture injected before the spinal analgesia wore off completely from the incision site. In all cases, the LA mixture injected was 12 mL bolus of 0.125% bupivacaine mixed with 2 mcg/mL fentanyl, which was similar to patients in the epidural group. Insertion of femoral catheters was done using ultrasound guidance under aseptic precautions. The nerve was visualised in transverse view below the inguinal ligament; all catheters were then tunnelled subcutaneously to bring them out laterally near the respective anterior superior iliac spine.

In the Group - 1, three out of 20 patients had GA and 17 had spinal anaesthesia. In the CFB group, six out of 22 patients had GA and 16 had spinal anaesthesia. In patients of GA, premedication was done using 1 mg of midazolam and 100 mcg of fentanyl. Induction was done using propofol 1% solution (1.5 - 2.5 mg/kg) with rocuronium (0.6 mg/kg) for muscle relaxation. Intraoperative analgesia was maintained with bolus doses of fentanyl 25 mcg to keep the heart rate and blood pressure within the range of 20% of the baseline measured preoperatively. In all cases of GA, reversal was done with neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg) after confirming for at least three of the four (train of four) twitches with neuromuscular monitor. Similar to femoral catheters, all patients with epidural catheters were given a bolus of 12 mL of the same mixture before shifting to recovery.

In recovery, level of blockade and analgesia was confirmed with testing for cold sensation and pin prick. In both groups, further doses were given and recorded to achieve satisfactory analgesia before shifting to the ward. Post-operative regimen for analgesia included continuous infiltration of a mixture of 0.125% bupivacaine with 2 mcg/mL of fentanyl. The initial rate of infusion was set at 8 mL/h in both the groups, which was then titrated appropriate to the patient's level of pain by the Acute Pain Service (APS) personnel. The APS team would check on the patient twice each day. The change in rate was made after confirming no migration at the skin entry site and adequate level of sensory blockade by testing for cold (ice) and also pin prick. This was similarly done in both the groups. The rate was reduced only in cases where it continued to provide optimum pain relief with improving physiotherapy. Any such change in the rate was noted and considered for that hour. The average rate of infusion was calculated as the mean for the day. All patients in both groups had oral proxyvon (paracetamol + dextropropoxyphene hydrochloride) three times a day, given as a part of multimodal analgesia.

Primary outcome measures were: (1) VAS scores (0 – 10) for pain and (2) the use of rescue analgesic in the form of IV tramadol 50 mg bolus.

Pain was assessed by Visual Analogue Score (VAS). It was first advocated by Revill and Robinson[3] in 1976. VAS consists of a 10 cm line having at one end a label such as "No Pain" and at the other end a label such as the "Worst Pain." The patient simply marks the line to indicate the pain

intensity and the provider then measures the length of the line to mark a point scale. All the patients were instructed about the VAS and to point out the intensity of pain on the scale 0 - No pain, 10 - Worst pain.

VAS scores at rest were recorded each hour for the first 6 h and every 2 h after that. For the sake of statistical analysis, mean VAS score measured over the first 6, 6 - 24, 24 - 48 and 48 - 72 h were considered. The first 6 h were considered as the intensity of pain is supposed to be highest during this time period and often necessitates increasing titration of analgesics. Secondary outcome measures included (A) Rehabilitation-physiotherapy scores in the form of flexion, extension and range of motion, (B) Side-effects in the form of nausea-vomiting, hypotension, difficulty in passing urine requiring catheterisation and itching and (C) Patient satisfaction score.

A rescue analgesic was administered whenever requested for by the patient. The time and the quantity of tramadol used were also noted. Rehabilitation in the form of passive and active knee movements was initiated from post-operative Day 1. The rehabilitation team member would note the active knee flexion and extension scores measured by a goniometer and record them. Catheters were observed for catheter migration, infection and were taken out at the end of 72 h in all patients.

A patient satisfaction score on a scale of 1 - 10 (1 - least satisfied and 10 - most satisfied), was recorded before the patient was discharged from the hospital.

Statistical analysis was done according to SPSS version. Quantitative data underwent homogeneity of variance test. Data with homogeneity of variance were expressed as mean ± standard deviation (Mean ± SD). Comparison between two groups were done with independent 't' test.

RESULTS

A total of 60 patients belonging to ASA Grade I and II posted for total knee replacement surgeries were randomly selected. The patients were divided into 2 groups of 30 each.

Age in Years	Group - 1 (Epidural)		Group - 2 (Femoral)	
	No. of Patients	%	No. of Patients	%
45 - 55	7	23.3	4	13.3
55 - 65	13	43.3	11	36.6
65 - 75	9	30	12	40
> 75	1	3.3	3	10
Total	30	100	30	100
Mean±SD	66.54 ± 4.98		66.98 ± 5.02	
Gender				
Male	17	56	16	53
Female	13	44	14	47
	30	100	30	100

Table 1. Demographic Details in Study

The mean age of patient in Group - 1 was 66.54 ± 4.98 and in Group 2 was 66.98 ± 5.02 years. P value was > 0.05, which was not significant. No significant differences in gender is observed between the groups.

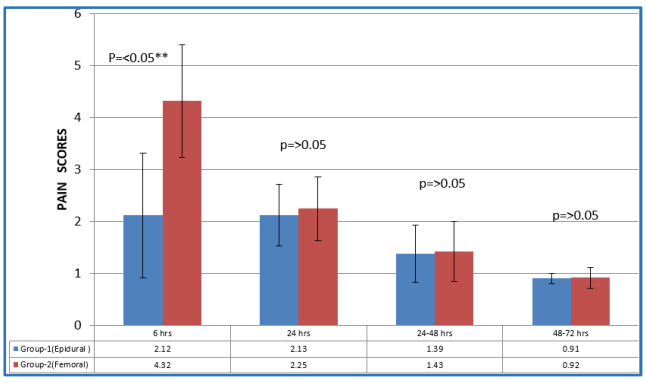

Figure 1. Graphical Representation of Post-Operative Pain Scores

Values are expressed as Mean ± SD. *P = < 0.05 is significant VAS scores were significantly high (P < 0.05) in the femoral group at 6 h, after which there was a declining trend and scores were essentially similar from 24 h. The use of rescue analgesic was also higher in the femoral group; 12 patients required a bolus of tramadol 50 mg with only one patient requiring 100 mg compared with 5 patients in the epidural group. This difference was not statistically significant.

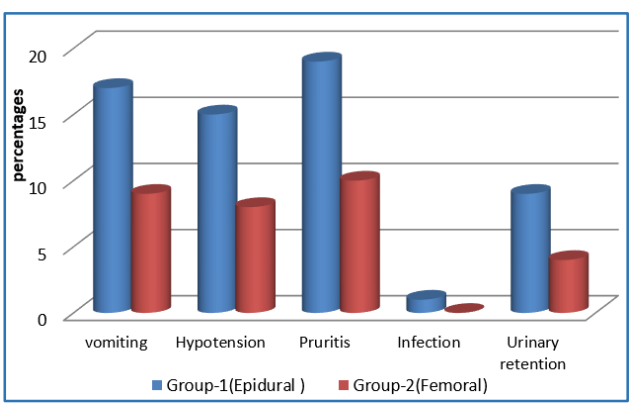

Figure 2. Graphical Representation of the Side-Effects in Percentages

Analysis of side-effects showed that all the five common side-effects were twice as common in the epidural group than in the femoral study group. Only one patient in the femoral group had urinary retention when compared with four in the epidural group.

The differences were not statistically significant. Four patients of the epidural group showed hypotension-systolic less than 90 mmHg. There were no infectious complications observed in femoral group, but one in epidural group.

Variables	Group - 1 (Epidural)	Group - 2 (Femoral)	P - value
Muscle power at 48 h	3.55 ± 0.67	4.25 ± 0.81	0.025*
Time getting out of the bed (hrs.)	59.59 ± 21.88	40.93 ± 16.04	0.002*
Time stay in hospital (days)	13.78 ± 1.89	12.56 ± 1.81	0.08*
Range of movement	35.02 ± 3.12	40.01 ± 4.12	0.12

Table 2. Variables in Study

*P = < 0.05 is significant

Muscle power at 48 h, Time getting out of the bed and Time stay in hospital (days) are significant in comparison in 2 groups; range of movement is insignificant in groups.

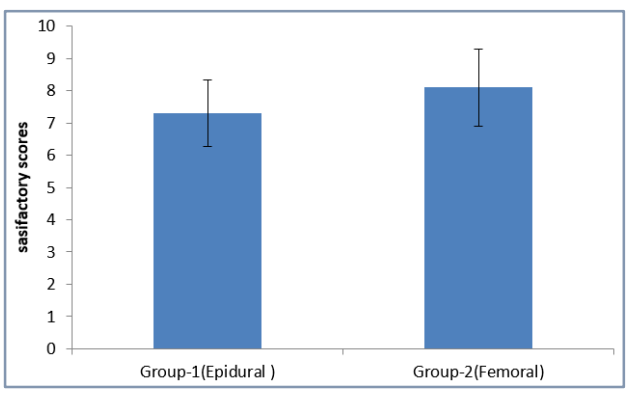

Figure 3. Patient Satisfaction Score

Patient satisfaction score was measured on a scale of 1 - 10. Patients in the femoral group were slightly more satisfied with a mean ± SD score of 8.1 ± 1.2 when compared with the epidural group 7.3 ± 1.01.

DISCUSSION

Rehabilitation after TKA is an important determinant of post-operative functional reconstruction of knee. The severe pain during excise is mainly caused by quadriceps spasm. Femoral nerve innervates the skin in front of knee and the quadriceps. Complete femoral nerve block may significantly attenuate the knee pain after TKA, make the quadriceps in a relaxed status and relieve the exercise-induced pain of affected limbs after TKA. Continuous femoral nerve block has special advantage in the analgesia after TKA.

Our study demonstrates that femoral blockade provides equivalent analgesia compared to epidural after TKR, except for the initial 6 hrs., during which time it was significant. Our study also demonstrates that the common side-effects are more common with the epidural group compared with the femoral group. Earlier studies comparing the two techniques show results consistent with the present study. In one of the studies, Barrington et al[6] showed equivalent analgesia between the two techniques. Even the meta-analysis by Fowler et al is in agreement with our finding except for the first 6 h.[7] The use of tramadol as a rescue analgesic mirrored the difference shown by VAS scores; however, this was not significant. Earlier studies using other opioids have shown similar results.[5,6,7]

The decreased efficacy of CFB compared with CEA in the first 6 h may be related to the sciatic nerve component for knee innervation, which was not blocked in the femoral group. Our observation showed that patients with CFB complained of pain in their calf. Anatomically, the knee joint derives its nerve supply predominantly from the femoral nerve; however, there seems to be an important component from the sciatic nerve that manifests as pain related to calf and leg.[8] Earlier studies are inconclusive regarding the necessity of sciatic blockade. The meta-analysis by Fowler et al[7] indicated no difference in pain scores between CEA and Peripheral Nerve Blocks (PNB), even when analysed separately with or without sciatic block. In a study by Ben-David et al,[8] 83% of the patients did not derive comparable analgesia with CFB alone and required addition of continuous sciatic infusion. Weber et al[9] reported that 67% of the patients who had a femoral block required sciatic block post-operatively. In fact, there are nearly an equal number of studies arguing sufficient[6,7] and insufficient blockade with femoral blockade alone.

Classic nerve stimulator guided peripheral nerve block has very high efficiency. Fanelli et al[10] and Franco et al[11] independently performed prospective studies with a large sample size and the effective rate was as high as 94% and 98.8%, respectively. However, the efficacy of nerve stimulator is still not optimal and might cause unpredictable damage to the nerve.[12] In recent years, the technique of ultrasound-guided femoral nerve block is improved significantly. When compared with nerve stimulator, ultrasound can display the nerves and surrounding structures, the anatomic variations, the location of needle and the diffusion and anaesthetics. A meta-analysis showed that guided nerve location has higher success rate as compared to nerve stimulator. In addition, this procedure is time-consuming, the nerve block is rapidly acquired and the block is long-lasting.[13] Studies also reveal that this procedure has better block efficiency, reduces the dose of local anaesthetics used and decreases the risk for damage to blood vessels.[14] In a systemically retrospective study, the anaesthetic effect was compared between ultrasound-guided nerve block and traditional nerve stimulator-guided nerve block. Results showed that the anaesthetic effect was comparable when these procedures were done by experienced physicians. Liu et al[5] found that there were no marked differences in the failure rate of nerve block, the degree of satisfaction and the severity of post-operative neurological symptoms after ultrasound- and nerve stimulator-guided nerve block. This might be attributed to the high success rate of both procedures conducted by experienced physicians and there is a little space for improvement of success rate. Currently, few studies are carried out to investigate ultrasound- and nerve stimulator-guided femoral nerve block. In the present study, ultrasound- and nerve stimulator-guided femoral nerve block

were performed after TKA, aiming to identify an ideal analgesic method after TKA.

The incidence of common side-effects observed with epidural was lower in the femoral group by more than half; it was clinically meaningful and perhaps the most evident difference given the equivalent analgesia and rehabilitation achieved with both techniques. Ultrasonography is highly dependent on the skill of operators,[15] and ultrasound cannot completely abolish the possibility of damage to nerves.[16] Thus, physicians still pay attention to the side effects of this procedure.

Patient satisfaction score measured on a scale of 1 – 10; patients in the femoral group were slightly more satisfied with a mean ± SD score of 8.1 ± 1.2 when compared with the epidural group 7.3 ± 1.01, showing femoral as efficient technique.

However, the duration of this study was still short and the long-term effect of analgesia in different ways is required to be closely monitored. Whether femoral blockade can reduce the damage to nerve is required to be determined in future studies.

CONCLUSION

We conclude that continuous femoral blockade using US guidance provides equivalent analgesia with a lower incidence of common side-effects when compared with continuous epidural analgesia. It is also patient satisfaction is comparatively more on femoral blockade.

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