ORIGINAL RESEARCH

Evaluating the efficacy of ultrasound guided adductor canal block in patients undergoing knee surgeries; A single blinded randomised controlled study

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Abstract

Background and aim: Knee surgeries require adequate post operative pain management. Adductor canal block (ACB) is a relatively new block with promising results. This study aims to evaluate the effect of USG guided ACB in post-operative analgesia for knee surgeries.

Methods: This randomised prospective study was conducted among 65 adult patients undergoing knee surgery, were grouped into A and B. Both the groups received Inj Paracetamol 15mg/kg TDS post-operatively for pain management. In group B, post-operatively, USG guided ACB with placement of catheter and intermittent doses of 0.25% Levobupivacaine (20ml) was given. Patients were assessed for pain in Numerical Rating Scale (NRS) till 48 hours. On NRS >4, Inj. Tramadol 50mg IV was given for both the groups. The desired outcome was to achieve adequate analgesia and active and passive movements in knee joint post operatively at the end of 48 hours.

Results: The mean score on NRS at various time intervals till 48 hours was found to be significantly lower than the group A (p value <0.005). Mean of numbers of tramadol doses in 48 hours was significantly more among group A compared to group B (p value 0.041). It was also observed that at the end of 48 hours patients in group B were able to perform knee movements (active and passive flexion) better than group A patients (p value<0.005).

Conclusion: The study showed that adductor canal block with intermittent doses of local anaesthetic provides good analgesia with reduced requirement of opioids after knee surgeries. It also promotes early ambulation due to its motor sparing effect.

Keywords: knee surgeries, adductor canal block, analgesia, pain score, peripheral nerve block

Introduction

Knee surgeries are followed by moderate to severe postoperative pain[1].Inadequate post operative pain management might become chronic, leading to limitation of early ambulation and range of motion, risking thromboembolism, affects rehabilitation, patient satisfaction, and overall outcomes. At present, multimodal analgesia (MMA) is considered the optimal method for perioperative pain management through targeting numerous pain pathways.[2] Intravenous opioid analgesics that are traditionally used are insufficient for pain control and can have side effects. Epidural analgesia being another alternative, produces well-known side effects such as urinary retention and motor blockade causing hindrance in mobilization.[3] A peripheral nerve block (PNB) is an adjunct anesthesia technique used to improve postoperative pain and speed overall recovery.[4] Femoral nerve block (FNB) is one of the most commonly used PNB and has been widely accepted as the gold standard for analgesia. However, quadriceps weakness as the major downside of FNB led to the search for alternative nerve blocks.[5] In recent years, **adductor canal block** (ACB) has been introduced as a pure sensory nerve block with that preserves quadriceps strength promoting early ambulation and recovery post-operatively. The adductor canal contains the femoral artery, femoral

vein, saphenous nerve, nerve to vastus medialis and the posterior branch of the obturator nerve. Deposition of local anaesthetic in the canal provides analgesia to the medial aspect of the lower leg and ankle as well as the knee joint. This study was conducted among the knee surgery patientsto evaluate the analgesic efficacy of adductor canal block and ability to perform knee movements.

Methods

It was a randomised, prospective study conducted in a multispeciality hospital, Greater Noida, among adult patients undergoing knee surgeries.After approval from the Institutional Ethical Committee all patients were selected as per inclusion and exclusion criteria. The study was conducted from From January 2020 to July2021. All the patients, age 18-70 years, in the American Society of Anaesthesiologists' I–II, scheduled for knee surgery under spinal anaesthesia were enrolled in the study. Patients with known allergy to local anaesthetics, age <18 years and >70 years, ASA III and ASA IV, surgery performed under general anaesthesia, patients with infection at surgical site were excluded from the study. On the operating day, ASA standard monitors were attached and intravenous lines secured. Sub Arachnoid block was given under antiseptic and aseptic precautions. Drugs used were 0.5% Bupivacaine (heavy) with or without fentanyl.On completion of the surgical procedure, all the patients (both group A and B) were advised Inj. Paracetamol 15mg/kg IV (Intravenous) thrice daily for post-operative analgesia. First dose given on first complain of pain (NRS>4) and thereafter 8 hourly. On further complaint of pain intravenous Inj. Tramadol 50mg was advised as a rescue analgesic on NRS score>4. Patients under group B were prepared for the adductor canal block. Patient was positioned supine with the knee slightly flexed and externally rotated (as shown in figure1). The ultrasound machine was positioned so that the operator, insertion site and ultrasound machine could lie in series. A high frequency linear probe (>10MHz) was used. The probe was placed axially at the level of the central mid-thigh, visualising the femur. Then slided medially until the femoral artery becomes visible with the "boat shaped" sartorius muscle above (as shown in figure2). The depth was adjusted so that the femoral artery and adductor canal lied in the center of the screen. Femoral artery was scanned down to the point at which the artery dives posteriorly (the adductor hiatus), ultimately becoming the popliteal artery. The optimal position for insertion is immediately proximal to the adductor hiatus. The nerves were often seen anterolateral to the artery, but could not be easily visualized always.A Tuohy's needle (18 G) inserted from lateral to medial using an in-plane technique. This could be achieved via a steep angle traversing sartorius, or more horizontally, by piercing vastus medialis and travelling perpendicular to the ultrasound beam. Once the needle enters the adductor canal, the needle tip should lie immediately lateral or superficial to the femoral artery. An aspiration test was performed to confirm no vascular invasion and then 2-5 ml of normal saline given to look for hydrodissection. Once correct placement of needle was confirmed, test dose of local anaesthetic 2ml 0.25% Levobupivacaine given, ensuring spread around the nerve. On confirmation of no vascular invasion and spread of the drug around the nerve, the total volume 20ml of local anaesthetic, levo-bupivacaine 0.25%, was injected slowly aspirating frequently to rule out intravascular injection. Catheter was mounted through the needles and fixed at 20cm. Sterile dressing was applied. Further top-ups with 20 ml levo-bupivacaine 0.25% were given 8 hourly for first 24 hours and 12 hourly for next 24 hours. In total, 5 top-up doses of 0.25% levo-bupivacaine (20ml) were given to all the patients in group B.All the patients were assessed for post-operative pain in Numeric Rating Scale (NRS) ranging 1–10, 1 being the least and 10 being the worst pain described by the patient.NRS was assessed hourly for first 2 hours, 4 hourly thereafter till 24 hours and 12 hourly until 48 hours. Requirement of rescue analgesic was assessed in both the groups by noting the total number of times they received intravenous injection of Tramadol 50mg for the duration of 48 hours post operatively.The desired outcome was to achieve adequate analgesia post operatively till 48 hours with lesser requirement of rescue analgesic and facilitation of post-operative ambulation.

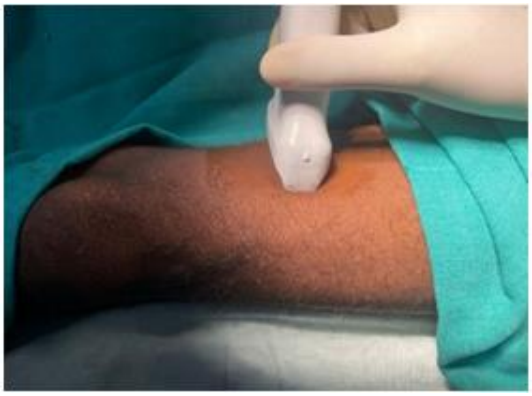

Figure 1: Patient positioning and placement of USG probe

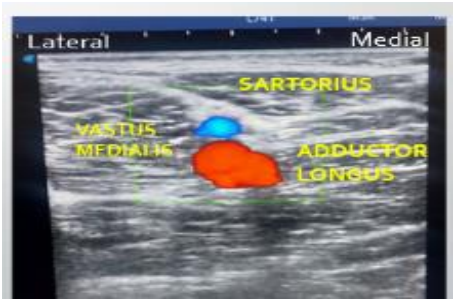

Figure 2: USG showing tracing of femoral artery

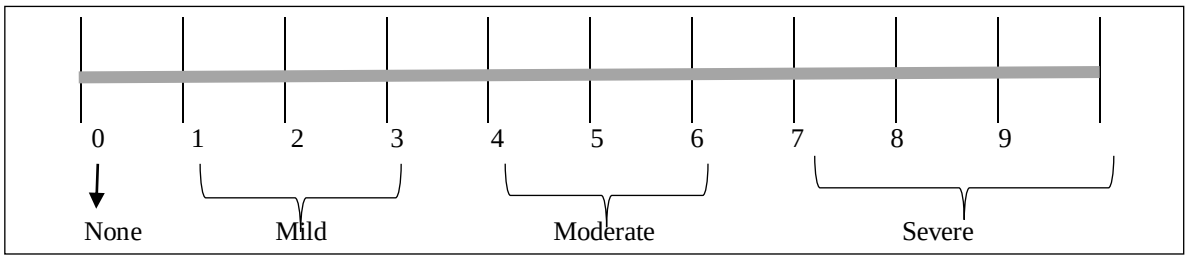

Figure 3: 0-10 Numeric pain rating scale

Each patient allocation was put in a serially numbered opaque sealed envelope and handed over to the procedure room anaesthesiologist. The anaesthesiologist who is an expert in the ultrasound guided adductor canal block was assigned for performing the block in all the patients in order to avoid technical bias. Pain score and movement assessor was the nurse and the physiotherapist of the ward, both blinded to the study groups. The

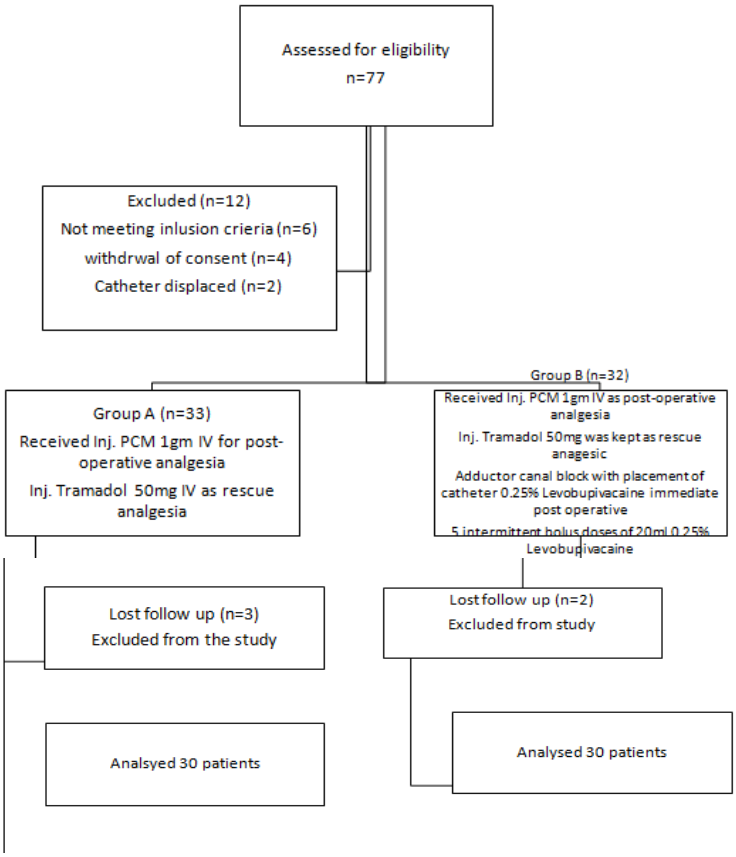

Figure 4: CONSORT

Results

Enrolment of participants was carried out between January 2020 and July 2021.Seventy-seven patients were approached for participation in this study. Twelve subjects were excluded due to not fulfilling inclusion consent

withdrawal, catheter displacement. Sixty-five patients were finally included and randomized to the group A and group B. 3 patients in group A and 2 patients in group B had been lost for follow. Finally, 60 patients completed the study and were analysed for outcomes. Out of 60 patients, 24 patients in the age group of 18-30 years, 23 were among 31-50 years, 13 patients in 51-70 years of age. The distribution of males and females were compared between group A and group B using the chi-square test.(Table 1) In this study 24 male and 6 female patients were there in group A. Group B included 27 male and 3 female patients.There was no significant difference in the distribution of males and females between group A and group B (χ^2 value = 2.008, p-value = 0.156)

Gender	Group A	Group B
Male	24	27
	80.0%	90.0%
Female	6	3
	20.0%	10.0%
χ^2 value = 2.008, p-value = 0.156		

Table 1: Percentage distibution of gender in study groups

The mean NRS score between the two groups were assessed at different time intervals from 0 min to 48 hours post-operatively. The pain score was assessed hourly for first 2 hours, thereafter 4 hourly till 24 hours, thereafter 12 hourly till 48 hours. The most significant finding was at 24 hours (p value 0.027). The mean score among the group B patients was found to be significantly lower than the group A at all the intervals of time.(Table 2).

NRS score	Group A		Group B				
	Mean	Std. Deviation	Mean	Std. Deviation	Mean Difference	t-test value	p-value
0 hour	1.19	1.59	0.95	1.00	0.24	1.983	0.152
1 hour	2.68	1.02	2.25	1.08	0.43	2.295	0.040*
2 hours	3.78	1.21	3.19	1.13	0.59	2.303	0.045*
4 hours	5.89	2.34	5.36	1.65	0.53	2.488	0.043*
8 hours	4.70	0.87	3.82	1.24	0.88	3.229	0.039*
12hours	4.15	1.57	3.18	1.70	0.97	3.616	0.032*
16hours	3.78	1.28	3.04	1.98	0.74	2.393	0.047*
20hours	3.63	1.50	3.06	1.97	0.57	2.895	0.046*
24hours	3.30	1.23	2.61	1.12	0.69	2.272	0.027*
36hours	3.04	0.76	2.39	0.86	0.65	3.028	0.037*
48hours	1.96	0.52	1.33	0.65	0.63	3.102	0.033*

Table 2: Comparison of Pain scores between the two groups on NRS

Inj. Tramadol was kept as the rescue analgesic and administered on NRS score of 4 or more. Mean of numbers of tramadol doses given in group B was found to be lesser (3.15) than in group A (4.07) (as per table 3). There was significantly lower requirement of tramadol among group B as compared to group A in the present study (p-value 0.041)

	Mean of nos. of doses	Std. Deviation	Mean Difference	t-test value	p-value
Group A	4.07	0.92	0.92	3.403	0.041*
Group B	3.15	1.06			

Table 3: Mean of nos. of Tramadol doses in both the groups

Movement of the lower limb was assessed among both the two groups at the end of 48 hours (post-operative day 2). The parameters included taking one step, standing, active flexion of knee joint, passive flexion of knee joint (Table 4). In group B, 19 out of 30 patients were able to perform active knee flexion whereas in group A only 7 patients were able to do the same (p-value 0.027). In group B a total of 26 patients were able to perform passive flexion of the knee joint but in group A total of 17 patients could perform the same.

		Group A	Group B	Chi-square value	p-value
Able to take one step	No	30	27	3.000	0.048*
		100.0%	90.0%		
	Yes	0	3		
		0.0%	10.0%		
Able to Stand up	No	27	24	7.576	0.028*
		90.0%	80.0%		

	Yes	3	6		
		10.0%	20.0%		
Active flexionat 45^0 knee joint	No	23	11	7.458	0.027*
		76.7%	36.7%		
	Yes	7	19		
		23.3%	63.3%		
Passive flexion at 45^0 knee joint	No	13	4	6.730	0.048*
		43.3%	13.3%		
	Yes	17	26		
		56.7%	86.7%		
Active toe movement	No	9	2	5.939	0.035*
		30.0%	6.7%		
	Yes	21	28		
		70.0%	93.3%		

Table 4: Movement assessed at the end of 48 hours post operatively

Discussion

Following knee surgery, major aims include adequate post-operative pain management to aid early physical rehabilitation and allow patients to return to physical activity and release from the hospital as soon as possible. Patients have moderate to severe postoperative acute pain, which can develop chronic if not well addressed. In recent years, adductor canal block (ACB) has been introduced as a pure sensory nerve block for postoperative analgesia following knee surgery. Pain score, assessed on Numerical Rating Scale (NRS) post-operatively up to 48 hour was chosen as the primary outcome in this study. Acute postoperative pain following knee surgeries is maximum during the first 24-48 hours.[6] Assessing pain for this time duration determining adequate analgesia for starting physical therapy, as the first physical therapy session was initiated 24-48 hour postoperativelyIn this study, the mean NRS score between the two groups were assessed at time duration from 0 min to 48 hours post-operatively. The mean score among the group B (patients given Adductor Canal Block) patients was found to be significantly lower than the group A (control) at all the intervals of time. Similarly, a study conducted by Jessica et al. found that on administration of Adductor Canal Block as an adjunct to a multimodal pain protocol for primary TKA patients, there was a 90% reduction in NRS pain scores in the post-operative care unit and a 38% reduction at 12 and 24-h post-operatively which were all statistically significant.[7]Another study by Neil et al. documented that, ambulatory adductor canal catheters are a feasible analgesic modality after knee arthroplasty surgery as pain scores remained low and adverse events were minimal.[8]Movement of the lower limb was assessed in the current study among both the groups at the end of 48 hours (post-operative day 2). Taking one step, standing, active flexion of knee joint, passive flexion of knee joint, all were significantly better among the patients in group B compared to group A. Active toe movement was also assessed and compared in both the groups and it was found to be significantly better in group B compared to group A, attributed to better pain control in group B. On assessment of the requirement of rescue analgesic among the patients, there was significantly lower requirement of tramadol among the patients who were supplemented with adductor canal block. In study by Jenstrup MT et al., it was found that, total morphine consumption from 0 to 24 h post-operatively was significantly less in the group which was given Adductor canal block with local anesthetic ropivacaine compared to the placebo group.[9]The Adductor Canal Block is basically entirely sensory, with only the vastus medialis muscle potentially impacted in terms of motor function. Our findings suggest that, the patients who were given ACB may improve early ambulation. Similar to present study, many studies documented the better range of movement in the knee joint among the patients with adductor block compared to without block.[9,10,11]Prior to the discovery of ACB, for years, femoral nerve block (FNB) had been considered as the main peripheral nerve block for postoperative analgesia following knee surgery.[12] However, FNB was found to be associated with reducing quadriceps muscle strength, which limits extension of the knee and increases risk of falls postoperatively.[13] In contrast, adductor canal block is predominately a sensory nerve block preserving the quadriceps strength.A randomised study by Zaric et al, 48 patients were analysed and it was observed that, quadriceps strength was significantly lower in the FNB group compared to the ACB group. However there was no significant difference in the pain relief for both groups.[14]A study by Jeff C Gadsden et al. also concluded that adductor canal block is a useful technique for postoperative pain following total knee arthroplasty, but it does not provide equivalent analgesic efficacy to femoral nerve block.[15]However, more research trials are to be done to evaluate efficacy of Adductor Canal Block and its

advantages over Femoral Nerve Block in knee surgeries for postoperative pain relief.

Limitation

There are certain limitations to this research. First, the success of the block was not validated after the bolus injection since the ACB was administered so soon after surgery that most patients' spinal anaesthetic had not yet worn off. Second, to meet the sample size, we had to include patients with knee fractures and lower limb fractures around the knee joint, where patients' pain scores were not so reliable as they did have injuries other than the knee joint.

Conclusion

An ideal postoperative analgesic should provide sufficient pain relief with minimal opioid consumption and preservation of motor strength. This study demonstrates that the use of Adductor Canal Block as a part of MMA after knee surgeries provides effective analgesia. This result is strengthened by the fact that the pain scores were significantly lower in the patients who were supplemented with Adductor canal Block compared to the group which was not given the block. It was also found that the requirement of rescue analgesia was significantly lower in patients receiving ACB. Furthermore, it was also observed that patients receiving ACB were better able to perform knee movements on postoperative day 2. Adductor Canal Block is being relatively a new technique and hence large-scale studies are needed to reinforce the promising results and its advantages over other analgesic modalities.

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