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Postoperative analgesia after arthroscopic anterior cruciate ligament reconstruction: A comparison between intra-articular ropivacaine injection and adductor canal block, A prospective cohort study

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Abstract
Background: Postoperative pain in arthroscopic acl reconstruction causing delay in rehabilitation protocol resulting in significant morbidity.opiod medications may have significant pain control but systemic adverse effects are of main concern. Delivering Ropivacaine either intraarticularly or by saphenous nerve block in adductor canal will reduce systemic adverse effects or are more effective in pain control.our study focuses on comparing effectiveness of adductor canal block versus intraarticular injection of ropivacaine in postoperative pain control.
Materials and Methods: 60 patients undergoing arthroscopic acl reconstruction by same operating surgeon under spinal anaesthesia are divided into three groups. group A patients were given adductor canal block with 30 ml 0.2 % ropivaciane under ultrasound guidance postoperatively, group B patients were given intraarticular injection with 30 ml 0.2 % ropivaciane postoperatively, group c or control patients receiving routine analgesia. Visual Analogue Score (VAS), Amount of morphine consumption,post op knee range of movement achieved was recorded at intervals of 6, 12, 24, 48 hours after the procedure.
Results: The intraatrticular group, adductor canal block had lower vas at 6,12,24 hours ($p < 0.05$) and at 48hours ($p > 0.05$) compared to control group. The intraaticular group required 30mg less total morphine consumption compared to control group at 48 hours,required 10mg less total morphine consumption compared to adductor canal block at 48 hours.post op knee rom improved in both the groups compared to control group ($p > 0.05$) but statistically not significant.
Conclusion: Both Intraarticular ropivacaine injection & adductor canal block are equally efficacious in pain control during first 24 hours after arthroscopic acl reconstruction compared to control group. However intraarticular injection group requires less amount of morphine consumption than adductor canal block group Because intraarticular injection is easy and does not require technical expertise as in nerve blocks and also does not require special equipment like ultrasound, So we recommend intraarticular ropivacaine injection as an effective pain control solution for postoperative pain control in arthroscopic ACL reconstruction.

Keywords: Adductor canal block, intraarticular injection, ropivacaine, visual analog scale (VAS)

Introduction
Arthroscopic anterior cruciate ligament reconstruction is one of the commonly done procedure in a modern orthopaedics setup. Post-operative pain causes delay in rehabilitation of the patient and increases the patient morbidity. Eventhough oral opioids and NSAID provide good post-operative pain control, but are associated with systemic side effects and they are not site specific. Early post-operative pain is well controlled by the use of local anaesthetics,either through intra-articular injection or continuous epidural block or regional nerve blocks [1, 2].
Ropivacaine has low molecular weight compared to bupivacaine and has less cardiotoxicity. Intraarticular delivery of local anaesthetic agent has proven to be more efficient and less toxic compared to regional nerve blocks [3, 4].
Epidural block and femoral and sciatic blocks are associated with motor weakness compared to Adductor canal block of saphenous nerve which is a pure sensory nerve block without any effect on motor function [5, 6].

It has been demonstrated to have a positive impact on post-operative pain control and early mobilization and morphine consumption after total knee arthroplasty [7, 8, 9]. There are limited studies in literature comparing intra-articular ropivacaine vs adductor canal block. The purpose of this study is to compare the analgesic efficacy of intra-articular ropivacaine and adductor canal block in post-operative pain control following arthroscopic acl reconstruction.

Materials and methods

It is a prospective cohort study. This study was conducted in the GEMS Hospital, Ragolu. The patients undergone arthroscopic anterior cruciate ligament reconstruction between August 2017 to august 2019 were included in this study.

All the patients undergoing arthroscopic anterior cruciate ligament reconstruction at GEMS HOSPITAL were included in this study and patients with preexisting neuropathies, chronic pain syndrome, opioid dependence, poorly controlled diabetes mellitus and not willing to participate are excluded from the study. 60 patients were allocated into three groups according to the mode of postoperative analgesia.

Group A patients were given adductor canal block and Group B patients were given intraarticular injection Groups C patients received routine analgesia.

All the surgeries were performed under spinal anaesthesia, under tourniquet application, by the same surgeon. At the end of surgery intra-articular injection of 0.2 % ropivacaine (7.5 MG /ML) 3mg /kg bodyweight was given by the surgeon through one of the portals and adductor canal block with 0.2 % ropivacaine (7.5 MG /ML) 3 mg /kg bodyweight was given by the anaesthetist at the midthigh region to block saphenous nerve under ultrasound guidance.

In the post-operative period all patients were monitored for any adverse reactions for the first 4 hours. Visual Analogue Score (VAS), amount of morphine consumption, post op knee ROM was recorded at intervals of 6, 12, 24, 48h after the procedure.

Statistical analysis

Statitistical significance analysed by calculating p value using unpaired t test for mean VAS score, amount of morphine consumption controlling age, gender, BMI, Operative time by multiple linear regression analysis. pvalues are documented in below table.

Results

VAS scores, amount of morphine consumption were calculated for both the groups 6,12,24,48 hours postoperatively (table 1) (table 2) p value calculated at 6,12,24,48 hours for both the groups. (Table 3) (Figure 1).

The vas score at 24 hours was lower in intraarticular group compared to adductor canal block group (table 3) But the difference is statistically not significant. Mean duration of stay is 24 hours. No adverse reaction has been recorded in either of the groups.

The intraaticular group required 30mg less total morphine consumption compared to control group at 48 hours,required 10mg less total morphine consumption compared to adductor canal block at 48 hours.post op knee rom improved in both the groups compared to control group (p>0.05) but statistically not significant.

Table 1: Group A Number of patients and VAS values

VAS	4H	8H	12H	24H
0	7	5	3	1
1	3			6
2	1	2	7	3
3	3	2	1	
4	1	3	1	6
5	1	3	1	
6	3	3	5	3
7	1	1	2	
8		1		1
9				
10				

Table 2: Group B Number of patients and VAS values

VAS	4H	8H	12H	24H
0	6	4	4	1
1	3	4	3	1
2	3	2	2	9
3	3	2	1	6
4	2	2	3	
5	1	2	3	1
6	1	2	2	1
7	1	1	2	
8		1		1
9				
10				

Table 3: Group C number of patients and VAS values

VAS	4H	8H	12H	24H
0	4	4	4	1
1	3	2	3	1
2	2	2	2	7
3	3	3	2	5
4	4	4	2	3
5	1	2	3	1
6	2	2	1	1
7	1	2	3	
8		1		1
9				
10				

Table 4: Mean VAS scores at 4, 8, 12, 24 hours

Mean Vas	4H	8H	12H	24H
Group A	2.4	3.5	3.5	3.1
Group B	2.2	2.95	3	2.8
Group C	2.8	3.75	3.15	3.05

Table 5: p value Comparision of the Group A with Group C at 4, 8, 12, 24 hours

Mean Vas	4H	8H	12H	24H
Group A	2.4	3.5	3.5	3.1
Group C	2.8	3.75	3.15	3.05
P value	0.8553			

Table 6: p value Comparision of the Group B with Group C at 4, 8, 12, 24 hours

Mean Vas	4H	8H	12H	24H
Group B	2.2	2.95	3	2.8
Group C	2.8	3.75	3.15	3.05
P value				

Table 7: p value Comparision of the Group A with Group B at 4, 8, 12, 24 hours

Mean Vas	4H	8H	12H	24H
Group A	2.4	3.5	3.5	3.1
Group B	2.2	2.95	3	2.8
P value	0.3905	0.2445	0.3219	0.3152

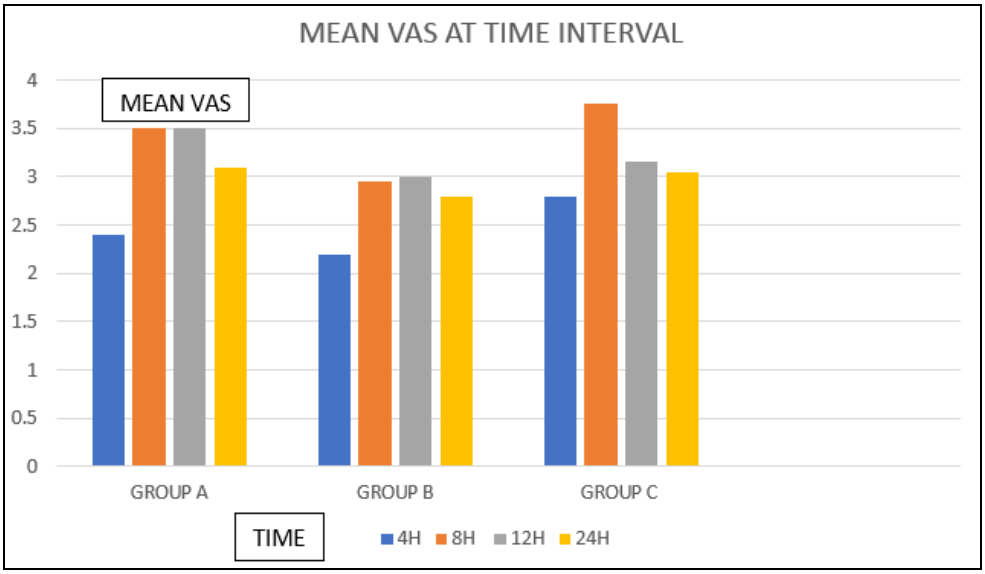

Chart 1: Mean VAS scores Comparison of the two groups at 4, 8, 12, 24 hours

Table 8: Comparison of studies

Study	Number of patients	Anae	Cohort 1	Cohort 2	Nerve block time	conclusion
Chisholm *et al.* [12]	80	SA	Saphenous nerve block with10 ml of 0.5% bupivacaine	Femoral nerve block with with30 ml of 0.25% bupivacaine	Pre-operative	similar
El-Ahl. [13]	128	GA	Saphenous nerve block 15 ml of ropivacaine 5%	Femoral nerve block 15 ml of ropivacaine 5%	Post-operative	Lesser analgesia Higher quads strength
Espelund *et al.* [15]	50	GA	Adductorcanal-block with 30 ml ropivacaine 7.5 mg/ml	Adductor-canal-block with 0.9% saline	Post-operative	Acb with ropivacaine is good option
Iskandar *et al.* [17]	80	GA	Single-injection FNB 20 mL 1% ropivacaine;	single IA bupivacaine injection 20 mL 1% ropivacaine;	Postoperative	Single-injection FNB is superior
Dauri *et al.* [18]	50	SCIATIC NERVE BLOCK	Continuous-infusion FNB (2 mg/mL of ropivacaine at 7 mL/hr)	continuous IA and wound-site bupivacaine infiltration (ropivacaine 2 mg/mL at 2 mL/hr)	preoperative	Continuous-infusion FNB superior
Mehdi *et al.* [19]	50	SA	Single-injection FNB 30 ml of 0.375% bupivacaine	single IA bupivacaine injection 40 ml of 0.25% bupivacaine	Preoperative	Similar
Mayr *et al.* [20]	157	SA	3-in-1 FNB	preoperative IA fentanyl-bupivacaine injection	preoperative	Preoperative Ia injection is equal to 3 in 1 fnb
Woods. [21]	90	GA	Continuous-infusion FNB 30 to 40 mL of 0.5% ropivacaine	IA injection of 20 mL of 0.5% bupivacaine and epinephrine (1:200 000)and 10 mg morphine with	preoperative	similar
Karlsson *et al.* [23]	40	gA	IA 20 ml, 0.375%bupivacaine injection	IA 20 ml saline injection		ia bupivacaine injection superior
Parker *et al.* [24]	63	ga	Continuous IA 0.25% bupivacaine	continuous IA 0.9% saline	4 mL/hr for 72 hours infusion	continuous ia bupivacaine infusion superior
Our study	40	SA	adductor canal block 30 ml 0.002 % ropivacaine	intra-articular injection of 30 ml 0.002 % ropivacaine	Postoperative Ultrasound guided	Intraarticular injection is Easy and effective

Discussion

Many methods of post-operative pain control have been described for knee arthroscopy patients in the literature. Even though opioid drugs are efficient in providing post-operative analgesia in the patients undergoing knee arthroscopy but are associated with untoward side effects. previous publications in the literature included all the knee arthroscopy procedures in their studies. We restrict our study to arthroscopic anterior cruciate ligament reconstruction procedure only.

In our prospective cohort study we have compared the analgesic efficacy of adductor canal block and intra-articular ropivacaine following arthroscopic anterior cruciate ligament reconstruction using hamstring graft. Our results revealed that there is no statistically significant difference in pain control, amount of morphine consumption between the two procedures in first 24 hours. There are limited studies in the literature comparing adductor canal block with intraarticular ropivacaine injection.

Convery *et al.* [11] studied the plasma concentrations of ropivacaine and they found that for all patients and all doses (100–200 mg) fell below the estimated toxic thresholds, and therefore it seems that ropivacaine can be safely administered by intra-articular injection. Samoladas *et al.* [3] found that intra-articular ropivacaine is effective to reduce postoperative pain minimizing the use of systemic analgesia. This study also said that, intra articular injection of local anesthetic seems to provide an alternative and effective solution in pain control after knee arthroscopy.

Adductor canal block is easy to perform and it is pure sensory blockade without affecting the quadriceps function so helps in

early mobilization. The various studies in the literature using adductor canal block in arthroscopic anterior cruciate ligament reconstruction are mentioned in the below table.

Chisholm *et al*. [12] and *et al*. [13] compared the Adductor canal block with the femoral nerve block post ACL reconstruction. Chisholm *et al*. [12] stated that there were no significant difference between the two groups in pain score at rest, and opioid consumption within postoperative 24 hours. However, they were in doubt about the causes of quadriceps muscle weakness in their study and they attribute it to the FNB or the original injury, therefore, they recommend assessing quadriceps muscle over six or nine month follow up in another study. In the other study *et al*. [13] concluded that in spite of significant preservation to the quadriceps muscle power in the ACB group than FNB group, the VAS pain score and opioid consumption was significantly higher in the ACB group. Espelund *et al*. [15, 16] in two different studies compared the ACB and placebo, one study in the minor arthroscopic surgery and the other for postoperative moderate and severe pain after arthroscopic knee surgery. They concluded that there were no significant analgesic effect of the ACB could be detected after minor arthroscopic knee surgery with a basic analgesic regimen. However, the ACB was highly reproducible and low risk option. In our study mean vas pain score at rest in ACB GROUP was lower and associated with statistically significant pain relief.

Intraarticular injection is surgeon controlled and easy to perform just before the closure and associated with less adverse effects. Various studies comparing intraarticular injection with nerve blocks mentioned in table 4.

Iskandar *et al*. [17] in their study concluded that even though femoral nerve block (FNB) provides longer duration of analgesia and significant morphine-sparing effect, the mean VAS score in the recovery room and during rehabilitation was higher in the intra-articular group compared to femoral group.

Dauri *et al*. [18] in their study reported lower VAS values and significant morphine sparing effect in continuous femoral nerve block group compared to Continuous Intra-articular and Wound Infusion.

Mehdi *et al*. [19], Mayr *et al*. [20] Woods [21] in their studies concluded that intra aticular injections are equally effective and easy to use compared to femoral nerve blocks is superior in terms of early mobilization and quadriceps wasting. Karlsson *et al*. [23], parker *et al*. [24] in their studies conclude that intraarticular local anaesthetic injection seems to be an effective alternative in pain relief and reduces the need for analgesic medication.

Limitations of the present study are small sample size, prospective study our results are correlating with the previous studies in the literature in terms of significant pain relief, decreased need for supplementary analgesia in first 24 hours resulting in decreased length of stay.

Conclusion

Intraarticular ropivacaine injection seems to provide an effective and alternative solution in pain control and easy to use compared to adductor canal block in first 24 hours after arthroscopic anterior cruciate ligament reconstruction. Adductor canal block requires ultrasound guidance and anaesthetist assistance to give the drug where as intra-articular ropivacaine injection can be given by the surgeon through arthroscopy portals while closing the wound. So we recommend intraarticular ropivacaine injection as an effective pain control solution after arthroscopic ACL reconstruction. There is no statistically significant difference between three groups.

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