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COMPARISON OF POSTOPERATIVE ANALGESIC EFFICACY OF POST SURGICAL SINGLE SHOT OF ADDUCTOR CANAL BLOCK VERSUS CONTINUOUS EPIDURAL ANALGESIA IN PATIENTS UNDERGOING TOTAL KNEE ARTHROPLASTY -A PROSPECTIVE RANDOMIZED CONTROL STUDY

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ABSTRACT **Introduction –** Total knee arthroplasty is one of the most painful procedures. In this study we intended to compare two analgesic modalities i.e. single shot of Adductor canal block & Continuous epidural analgesia in terms of good post-operative analgesia, minimal motor involvement, good post-operative muscle strength thus allowing faster rehabilitation and recovery thereby improving the final outcome of TKR in long term.

Material and method- A total of 60 patients were enrolled, 30 in each group. Group A received Standard General anesthesia & postoperative analgesia with a single shot of adductor canal block with 20cc of 0.25% ropivacaine. Group B received Combined spinal-epidural block & postoperative analgesia was maintained on continuous epidural infusion in the form of a mixture of 0.125% ropivacaine & fentanyl(2microgram/cc) at the rate of 6ml/hour.

Result- Group B patients required a greater number of rescue analgesic doses in comparison to Group A patients. The majority of the patients in Group A had early postoperative mobilization in comparison to Group B (p=0.003). Mean preoperative and 6-week postoperative WOMAC scores showed that difference was statistically significant (p=0.034), showing a significantly lower 6-week postoperative WOMAC score in Group A in comparison to Group B.

Conclusion – Our study gives us a conclusion that the post-surgical Single Shot of the adductor canal block is a better post-operative analgesic modality when compared with continuous epidural analgesia post-surgically in terms of better pain relief, good post-operative muscle strength, early mobilization of the patient, higher patient acceptability.

KEYWORDS : Total knee arthroplasty, Adductor canal block, Continuous epidural analgesia

Introduction - Primary total knee joint arthroplasty (TKA) is among the most frequent procedures performed by orthopedic surgeons & it is often cited as the most effective treatment for end-stage knee arthritis[1],[2],[3] . It is often cited as one of the most painful procedures [1],[2],[3].

After knee surgery, pain inhibits early rehabilitation & mobilization of the knee joint.[11] This acute immediate post-operative pain is also a known predictor of chronic post total knee arthroplasty pain [24]. The postoperative analgesic regimen should aim to reduce morbidity and enhance functional recovery as well as provide efficient analgesia with minimal side effects and minimal or no motor involvement.

Traditionally continuous epidural analgesia remained the major option for the postoperative pain management of total knee arthroplasty but it has some associated undesirable systemic side effects such as hypotension & post-operative urinary retention and motor blockade which delays the rehabilitation.[7]

Another option for postoperative pain control is the administration of intravenous (IV) opioids after surgery, but it is often associated with serious systemic side effects.[3],[4]. Femoral nerve block (FNB) a substitute to opioid analgesia for postoperative pain control measures is a good option but it also has a disadvantage of the associated motor blockade which delays early mobilization and rehabilitation of patients.

A number of different nerves traverse the adductor canal (Hunter's canal), including the saphenous nerve, the nerve to the vastus medialis, the posterior branch of the obturator nerve, and in some cases, the medial cutaneous nerve and the anterior branch of the obturator nerve.[14] Except for the nerve to the vastus medialis, these branches have a sole sensory function. Thus continuous Adductor Canal block (ACB) can be a good alternative and effective treatment to reduce pain, as it blocks the sensory input from the anterior side of the knee with minimal effect on motor supply but with continuous adductor canal block chances of proximal extension of the blockade are high resulting in motor involvement, also drug delivery catheter hampers the mobilization of the patient. Thus, an ultrasound-guided post-surgical single shot of the adductor canal block can be a good option but posterior knee pain control, which is under the innervation of the sciatic nerve is not possible neither with femoral nor with adductor Canal Block.

Thus, infiltration of Local anesthetics through arthrotomy along with Adductor canal block is probably a good Pain control measure because it has an advantage of minimizing pain at the site of origin, and have minimal side effects. [6]

Hence, in this study we intended to compare two analgesic modalities i.e. single shot of Adductor canal block & Continuous epidural analgesia in terms of good post-operative analgesia, minimal motor involvement, good post-operative muscle strength thus facilitating early mobilization, the minimal associated risk of venous thromboembolism, less psychologically stressful to the patient & a higher patient satisfaction thus allowing faster rehabilitation and recovery thereby improving the final outcome of TKA in long term.

MATERIAL AND METHODS-

PROTOCOL- This study was conducted at Max Super-specialty Hospital F-50, C & D Block, Shalimar Bagh, New Delhi, 110088 & we enrolled all the diagnosed cases of osteoarthritis knee in adult, who are ready to undergo primary total knee replacement & who qualified our inclusion criteria. Our study design was a Prospective randomized study & it's a two-group study with a dichotomous variable.

PATIENTS –

A total of 60 patients (30 in each group) who were planned for total knee replacement and who qualified inclusion criteria were enrolled with block randomization technique. Patients not willing to be the part of study, contraindications to spinal or regional anesthesia, ASA Grade 3 and above, patient with hypersensitivity to anesthetic drugs, revision arthroplasty, major peripheral vascular disease of the lower extremity, a cerebrovascular disease with history of CVA, patient with significant cardiac comorbidity, morbid obesity – BMI more than 35 were excluded from the study. Written informed consent was obtained from all patients who were enrolled in the study.

All patients in our study received pre-emptive analgesia in the form of a combination of -Tablet Pregabalin 75mg with tablet diclofenac 75 mg per orally.

The Adductor canal is approximately halfway between the anterior superior iliac spine and the patella, at the mid-thigh level.[9] To administer the adductor canal block an ultrasound transducer is placed transverse to the longitudinal axis of the extremity to identify the adductor canal underneath the sartorius muscle. The femoral artery is first identified as visible pulsations, with the vein just inferior and the saphenous nerve just lateral to the artery. The nerve is blocked at the location is so identified. (Fig 1.1)

In Group A, Standard general anesthesia was administered & midline surgical approach was used & knee joint exposed through medial parapatellar arthrotomy following which patella was everted and retracted laterally then after soft tissue balancing proximal tibial cut & distal femoral were taken with the help of zig and sizing was done with posterior referencing then anterior-posterior and chamfers cuts were made following which joint space was checked in flexion and extension with spacer following which LIA was given then tibial plate and femoral component were positioned into place with antibiotic palacos cement and then spacer of adequate size placed then thorough wash was given and closure done in layers and the aseptic dressing was done. After the completion of the surgery, an ultrasound-guided single shot of an adductor canal block was administered in which anesthesiologist located the femoral nerve precisely within the adductor canal & 20cc of 0.25% ropivacaine injected into the adductor canal around the femoral nerve.

In Group B, combined spinal-epidural anesthesia will be given. Sub-arachnoid block with 2-3ml 0.5% bupivacaine was administered. After establishing stable hemodynamics epidural infusion of in the form of a mixture of 0.125% Ropivacaine & fentanyl(2microgram/cc) at the rate of 6ml/hour was administered. The surgical procedure was the same as group A.

Intraoperatively 50 ml of local infiltrative anesthesia for each knee was administered in both groups in form of a mixture of 50mg ropivacaine, 1mg adrenaline, 15 mg morphine & 30 mg of triamcinolone diluted in normal saline and is injected 20 ml in the posterior capsule of the knee,15 ml in suprapatellar part of quadriceps muscle & 15 ml in the medial compartment just before the cementation of the arthroplasty components.

Postoperative protocol- Ankle flexion & extension exercises were started in bed immediately postoperatively. The patient was encouraged to sit on a recliner on the day of surgery. Day 0 was defined as the day of surgery. The first postoperative day was defined as the period between 6 am on the next day of surgery to 6 am of day next to it. The second postoperative day was defined as the period from termination of 1st postoperative day to 6 am of day next to it.

Postoperatively both the group received injection paracetamol 1 gm thrice and injection diclofenac sodium 75 mg twice a day for 3 days.

Patients were closely followed for 1st two days of surgery for

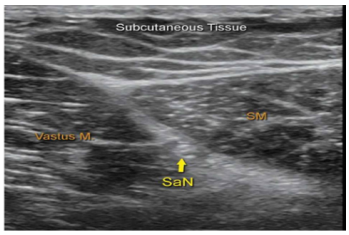
a. The requirement of rescue analgesia and its frequency post-operatively
b. Assessment of postoperative motor recovery with Modified Bromage Scoring.

In Group A whenever patient complaints of pain on and after day 1, VAS was assessed & single shot 20cc of 0.25% ropivacaine was injected into the adductor canal under ultrasound guidance as rescue analgesia & was administered only if VAS>3.

In Group B- The patient was maintained on continuous epidural infusion in the form of a mixture of 0.125% ropivacaine & fentanyl(2microgram/cc) at the rate of 6ml/hour. Whenever patients complained of pain on and after day 1 VAS was assessed & 0.25% ropivacaine 8cc bolus epidural block was administered as rescue analgesia & was administered only if VAS>3.

The short-term comparison of both study groups was done with the help of the above methodology but for long term comparison we evaluated the patient at 6 weeks after surgery with WOMAC functional outcome score.

Fig (1.1) ULTRASONIC IMAGE OF ADDUCTOR CANAL



STATISTICAL ANALYSIS- The data was initially entered into the customized proforma and then transferred to Microsoft Excel for analysis. Statistical software Minitab Version17.0 was used for calculating the P values. A comparison of means between the two groups was done using the Unpaired 't' test, the association between two non-parametric variables was done using Pearson Chi-square test, comparison of means within the groups at different time intervals was done using Paired 't' test. A p-value of <0.05 was taken as statistically significant. The final data was presented in the form of tables.

Results – A total of 60 patients were enrolled. The mean age in Group A was 62.00 ± 7.51 years, and in Group B it was 61.43 ± 8.94 years. The difference was found to be statistically not significant ($p=0.791$), showing a comparable mean age between the two groups **(Table 1**).

In Group A**,** there were 19 (63.3%) females and 11 (36.7%) males. In Group B, there were 22 (73.3%) females and 8 (26.7%) males. There was a female preponderance in both groups **(Table 2).**

The mean weight in Group A was 75.40 ± 4.04 kg and in Group B it was 73.77 ± 4.55 kg. The difference was found to be statistically not significant ($p=0.147$), showing a comparable mean weight between the two groups **(Table 3)**.

In Group A**,** 23 (76.7%) patients did not require any rescue analgesia and 7 (23.3%) patients required 1 rescue analgesia. In Group B**,** 4 (13.3%) patients did not require any rescue analgesia, 12 (40.0%) patients required 1 dose of rescue analgesia, 12 (40.0%) patients required 2 doses of rescue analgesia and 2 (6.7%) patients required 3 doses of rescue analgesia. Group B patients required a greater number of rescue analgesic doses in comparison to Group A patients **(Table 4).**

In Group A**,** 21 (70.0%) patients had no PONV, while 9 (30.0%) patients had PONV. In Group B**,** 26 (86.7%) patients had no PONV, while 4 (13.3%) patients had PONV. There was no statistically significant association seen between PONV and the groups ($p=0.117$), showing that the groups are independent of the postoperative PONV. In **Group A,** 26 (86.7%) patients had no postoperative urine retention, while 4 (13.3%) patients had postoperative urine retention. In **Group B,** 14 (46.7%) patients had no postoperative urine retention, while 16 (53.3%) patients had postoperative urine retention. There was a statistically significant association seen between postoperative urine retention and the groups ($p=0.001$), showing that the groups are dependent on the postoperative urine retention. A higher incidence of postoperative urinary retention was seen in patients of Group B**. (Table 5)**

The mean modified Bromage score in Group A was 3.80 ± 0.41 and in Group B it was 2.97 ± 0.81. The difference was found to be statistically significant ($p=0.001$), showing a higher mean modified Bromage score in Group A in comparison to Group B**. (Table 6)**

In Group A**,** 6 (20.0%) patients were mobilized on postoperative Day-1 and 24 (80.0%) patients were mobilized on postoperative Day-2. In Group B**,** 27 (90.0%) patients were mobilized on postoperative Day-2 and 3 (10.0%) patients were mobilized on postoperative Day-3. There was a statistically significant association seen between postoperative mobilization and the groups ($p=0.003$), showing that the groups are dependent on the postoperative mobilization. The majority of the patients in Group A had early postoperative mobilization in comparison to Group B **(Table 7).**

The mean preoperative WOMAC score in Group A was 72.40 ± 3.42, while in Group B it was 71.50 ± 5.86. The difference was found to be

statistically not significant (p=0.470), showing a comparable mean preoperative WOMAC score between the two groups. The mean postoperative WOMAC score in Group A was 28.87 ± 3.04, while in Group B it was 30.77 ± 3.72. The difference was found to be statistically significant (p=0.034), showing a significantly lower postoperative WOMAC score in Group A in comparison to Group B **(Table 8).**

The mean blood loss in Group A was 454.67 ± 77.05 ml, and in Group B it was 425.33 ± 71.67 ml. The difference was found to be statistically not significant (p=0.132), showing a comparable blood loss in Group A in comparison to Group B.

Table No. 1 Distribution Of Patients According To Age

Age Group	Group A		Group B	
	No.	%	No.	%
44-54 years	5	16.7	8	26.7
55-64 years	12	40.0	13	43.3
65-74 years	12	40.0	7	23.3
75-84 years	1	3.3	2	6.7
Total	30	100.0	30	100.0
Mean age (years)	62.00 ± 7.51		61.43 ± 8.94	
't' value and df	0.266, df=58			
P value	0.791, Not Significant			

Unpaired 't' test applied. P value = 0.791, Not Significant

Table No. 2 Distribution Of Patients According To Sex

Sex	Group A		Group B	
	No.	%	No.	%
Female	19	63.3	22	73.3
Male	11	36.7	8	26.7
Total	30	100.0	30	100.0

Table No. 3 Comparison Of Mean Weight Between The Two Groups

Groups	No.	Mean ± SD	't' value	P value
Group A	30	75.40 ± 4.04	1.471, df=58	0.147, NS
Group B	30	73.77 ± 4.55		

Unpaired 't' test applied. P value = 0.055, Not Significant

Table No. 4 Distribution According To Number Of Times Rescue Analgesia Given

Frequency of Rescue Analgesia	Group A		Group B	
	No.	%	No.	%
None	23	76.7	4	13.3
1	7	23.3	12	40.0
2	0	0.0	12	40.0
3	0	0.0	2	6.7
Total	30	100.0	30	100.0

Pearson chi-square value = 2.455, df=1, P value = 0.117, Not Significant

Table No. 5 Comparison Of Postoperative Urine Retention Between The Two Groups

Postoperative Urinary Retention	Group A		Group B	
	No.	%	No.	%
No	26	86.7	14	46.7
Yes	4	13.3	16	53.3
Total	30	100.0	30	100.0

Pearson chi-square value = 10.800, df=1, P value = 0.001,Significant

Table No. 6 Distribution According To Postoperative Modified Bromage Score

Modified Bromage Score	Group A		Group B	
	No.	%	No.	%
1	0	0.0	1	3.3
2	0	0.0	7	23.3
3	6	20.0	14	46.7
4	24	80.0	8	26.7
Total	30	100.0	30	100.0

Table No. 7 Distribution According To Postoperative Mobilization

Postoperative Mobilization	Group A		Group B	
	No.	%	No.	%
Day-1	6	20.0	0	0.0
Day-2	24	80.0	27	90.0
Day-3	0	0.0	3	10.0
Total	30	100.0	30	100.0

Pearson chi-square value = 9.176, df=2, P value = 0.010, Significant

Table No. 8 Comparison Of Mean Preoperative And 6 Weeks Postoperative Womac Score Between The Two Groups

	Group A [Mean ± SD] (n=30)	Group B [Mean ± SD] (n=30)	't' value	P value
Preoperative	72.40 ± 3.42	71.50 ± 5.86	0.727, df=58	0.470, NS
Postoperative	28.87 ± 3.04	30.77 ± 3.72	-2.167, df=58	0.034*

Paired 't' test applied. P value = <0.05 was taken as statistically significant

DISCUSSION -

Total knee arthroplasty is a painful procedure [1],[2],[3]. Pain control is essential for early mobilization, which reduces the risk of complications. There are not many studies comparing postoperative pain management by a single shot of an adductor canal block administered immediately after the surgery with that of continuous epidural infusion after total knee arthroplasty. Hence, in this study we intended to compare two analgesic modalities i.e. single shot of Adductor canal block (Group-A) & Continuous epidural analgesia (Group-B).

The mean age difference of patients in our study in both groups was found to be statistically not significant with female preponderance in both the groups.

In our study we used WOMAC scoring for preoperative evaluation of knee osteoarthritis & 6 weeks postoperatively to assess the recovery & functional outcome of the procedure. It is a self-administered questionnaire consisting of 24 items divided into 3 subscales; pain, stiffness, physical function.[18]

Higher scores on the WOMAC indicate worse pain, stiffness, and functional limitations.

The **mean preoperative WOMAC score** difference in our study was found to be statistically not significant (p=0.470), showing a comparable mean preoperative WOMAC score between the two study groups.

For pain assessment in our study we have used pain Visual Analogue Scale (VAS), ranging from 0 to 10 where 0 represents no pain and 10 represents extreme pain.

VAS scoring chart which we have used in our study is attached as Annexure-II

In our study **Group B,** more frequently developed pain & required administration of rescue analgesia in the first 48 hours postoperatively. Chan[10] et al. in their study compared the analgesic efficacy of Epidural Analgesia (EA) and FNB but they could not demonstrate a difference in pain control between FNB and epidural analgesia.

It has been observed that Femoral nerve block (FNB) reduces the strength of the quadriceps muscle by more than 80% [12] thus the ACB has been proposed as an alternative technique for pain management after TKA to avoid the disadvantage of FNB motor impairment [17]. In Jun Koh[16]et al. in their study found that ACB provides comparable analgesic efficacy and facilitates earlier mobilization by sparing quadriceps strength compared with FNB. Jenstrup [9] et al. in their study found that the adductor-canal-blockade significantly reduced morphine consumption and pain during 45 degrees flexion of the knee compared with placebo. Also, the adductor-canal-blockade significantly enhanced ambulation ability. Shah [13]et al found that compared with the SACB (Single Adductor Canal Block) method, the CACB (Continuous Adductor Canal Block has better efficacy in terms of pain control but was similar for early functional recovery. Some other recently published studies have different opinions. Perlas et al [15] in their retrospective study of 298 patients showed that LIA with the addition of ACB is associated with further increases in early ambulation, a more rapid transition to use of a standard low walker, and a higher incidence of discharge to home.

Modified Bromage Score is a frequently used measure of motor block. In this scale, the intensity of motor block is assessed by the patient's ability to move their lower extremities. **A higher score indicates the least motor involvement while a lower score indicates more motor blockade**.

In our study a higher mean Modified Bromage Score in Group A in comparison to Group B which indicates minimal motor blockade occurs with adductor canal block. Also, the majority of the patients in Group A had early postoperative mobilization in comparison Group B which again indicates that ACB is associated with the minimal motor blockade. Shah [13] et al data demonstrated that Range of Motion (ROM) among both the SACB and CACB groups at discharge and length of hospital stay displayed almost identical results with no statistical significance.

The **mean 6 weeks postoperative WOMAC score** showing a significantly lower 6 weeks postoperative WOMAC score in Group A in comparison to Group B which indicates better recovery of patients in group A which can be attributed to better postoperative pain control with ACB thus facilitating early mobilization when compared to continuous epidural analgesia.

The **mean blood loss** difference in both the groups was found to be statistically not significant (p=0.132), showing a comparable blood loss in Group A in comparison to Group B. Contrary to this Stundner [8] et al. in their study in 2012 observed neuraxial anesthesia is indeed associated with a highly significantly decreased intraoperative blood loss & decreased incidence of perioperative blood product transfusion.

The incidence of PONV seems to be higher in **Group A** but statistically it's not significant. S Hu [7] et al. in their metanalysis observed that the incidence of postoperative nausea and vomiting was significantly lower in the regional group than in the general anesthesia group.

Our study shows a higher incidence of postoperative urinary retention in patients of Group B. Similar observations was made by Brouwer T[20] et al, Lamonerie L[21] et al, Lau H[22] et al & Pavlin DJ[23] et al in their respective studies which reported a higher incidence of postoperative urinary retention in patients undergoing surgery under the subarachnoid block (SAB).

CONCLUSION -

Thus, our study gives us a conclusion that post-surgical Single Shot of adductor canal block is a better post-operative analgesic modality when compared with continuous epidural analgesia post-surgically in terms of

- Better pain relief
- Good post-operative muscle strength
- Early mobilization of the patient
- Higher patient acceptability

Thus, it allows faster rehabilitation & recovery of the patient & thereby increasing the functional outcome of the procedure in the long-term.

However further research with a larger study population is required to confirm the same

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