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Research Article

Comparative Study between Continuous Epidural Analgesia and Continuous Femoral Nerve Blockade for Pain Relief Following Total Knee Replacement Surgery

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ABSTRACT
Background: Total knee replacement surgery (TKR) is one of the most painful orthopaedic procedures, mandating effective postoperative pain management. Traditionally postoperative analgesia following TKR is provided by intravenous patient controlled analgesia, epidural analgesia and peripheral nerve blocks. Femoral nerve blockade is good analgesia method.
Aim and Objectives: To compare VAS scores at different time intervals, requirement of rescue analgesics and incidence of postoperative side effects or complications related to these techniques in postoperative period.
Methodology: A prospective observational study and done in Department of Anaesthesia at Sterling Hospital, Ahmadabad Gujarat over a period of six month (April 2017 to September 2017). Total 60 patients of age 50-75 yrs, ASA grade I and II undergoing for total knee replacement surgery were included in the study.
Results: Analysis revealed that there was significant difference observed in VAS scores between both groups. When ANOVA test was applied in two time interval (first 6 hrs and after 6 hrs) mean of VAS scores in group F is greater than group E before 6 hrs and in 6 to 48 hrs mean VAS scores of group E is more than group F. In three time interval (1 to 6 hrs, 6 to 24 hrs, 24 to 48 hrs) ANOVA test mean VAS score of group F more than group E in 1 to 6 hrs and 6 to 24 hrs while in 24 to 48 hrs mean VAS score of group E more than group F. VAS scores of one time interval are compared with VAS scores of other two time interval in post hoc test. The difference is significant at the .05 level. So VAS scores in one time interval is significantly different from other two time intervals. Need of rescue analgesia were more in patient of group F in 1-6 hrs. Incidence of hypotension, nausea and vomiting were not statistically significant in group E and group F.
Conclusion: Analysis revealed that there was significant difference observed in VAS scores between both groups. Epidural analgesia was found to be superior than continuous femoral blockade in pain relief in first 6 hrs. Need of rescue analgesia were more in patient of femoral nerve block in first six hours.

Keywords: Total Knee Replacement, Epidural Analgesia, Continuous Femoral Nerve Block, Visual Analogue Scale (VAS), Analysis Of Variance Test (ANOVA).

INTRODUCTION

Knee replacement surgery also known as knee arthroplasty can help to relieve pain and restricted function in severely diseased knee joint. Patients undergoing TKR, experience substantial and sustain postoperative pain. Inadequate analgesia may impede recovery of patient and delay hospital discharge. It impacts higher medical cost and more burdens on health care provider.

Extensive tissue damage in major operation, such as TKR causes immediate changes in endocrine system and central, peripheral and sympathetic nervous system and stimulates catabolic hormones release, resulting in compromised immunity, increased oxygen demand and higher strain on cardiovascular system.(1) In addition, immobilization caused by pain may increase the risk of decreased pulmonary function, gastrointestinal complication such as ileus and thrombus formation that are related to surgical stress. Uncontrolled severe immediate postoperative pain can develop into chronic pain due to sensitization of nervous system.(2)

The most important concept of current pain management following TKR is preemptive use of multimodal approach. Usually a multimodal regimen includes non-steroidal anti-inflammatory drugs (NSAIDS), opioids and regional anaesthesia (RA).

NSAIDS even in moderate dose causes serious side effects, especially in elderly population. Although potent analgesic, opioids are associated with some serious adverse effects, which might limit their analgesic potential.

Among RA techniques, continuous epidural analgesia has been mainstay for considerable period. Many studies have observed better pain relief with epidural analgesia than systemic opioids. Use of epidural anaesthesia and analgesia may be associated with reduction in incidence and severity of many perioperative physiologic disturbances. Recently, the number of patients receiving epidurals has declined because of increasing use of anticoagulant therapy as prophylaxis against perioperative deep vein thrombosis.

An alternative regional anaesthesia technique is peripheral nerve blockade (PNB) of one or more major nerve supply of lower limb. In peripheral nerve block, femoral nerve block (FNB) is frequently used. FNB is an easy technique to master and has lower risk of complication. FNB can be performed as single shot or as a continuous block using catheter infusion. Continuous nerve block has an advantage of permitting the delivery of analgesia for longer postoperative duration than single shot nerve block.

FNB does not provide motor blockade to non-operative leg which may encourage earlier ambulation. An increasing number of studies have reported multimodal analgesia featuring unilateral peripheral block provide pain relief and functional outcomes similar to that of continuous epidural and superior to systemic analgesia but with fewer side effects. Harsha Shanthaanna *et al.*[3] demonstrated that continuous femoral blockade using ultrasound guidance provides equivalent analgesia with a lower incidence of common side-effects when compared with continuous epidural analgesia.

The present study was designed to compare the postoperative pain between continuous epidural analgesia and continuous femoral nerve blockade in patients undergoing unilateral total knee replacement surgery.

Objectives

Objectives of this study were to compare VAS scores at different time intervals, requirement of rescue analgesics and incidence of postoperative side effects or complications related to these techniques in postoperative period.

MATERIALS AND METHOD

The present study was a prospective observational study and done in Department of Anaesthesia at Sterling Hospital, Ahmedabad Gujarat over a period of six month (April 2017 to September 2017). Various articles published in journals were also considered for deciding appropriate sample size. Based on a previous study, power analysis determined that a minimum of 30 patients in each group would be required to give an 80% power at a 2-sided alpha error of 0.05 to detect a clinically significant reduction in VAS scores.

After obtaining ethical committee clearance and written informed consent from each patient, 60 patients of age 50-75 yrs, ASA grade I, II undergoing for total knee replacement surgery were divided into two groups by simple random sampling without replacement. Only patients undergoing unilateral knee replacement surgery were included in study.

Exclusion criteria for study were

- Patients less than 50 yrs of age and more than 75 yrs of age
- ASA class III, IV
- Patients undergoing bilateral total knee replacement.
- Patient‘s refusal for procedure
- Coagulopathy or patients on anticoagulant drugs
- Infection on local site
- Peripheral neuropathy
- Nonpalpable femoral artery
- Allergy to study drugs

Each group had 30 patients. Group E had patients who received continuous epidural analgesia (E) and Group F had patients who received continuous femoral nerve block (F) for postoperative pain relief after surgery.

Nil by mouth status was confirmed. History was reviewed and procedure was explained to patients. Anaesthesia trolley was checked and all emergency drugs were kept ready. Then ECG, pulse oximeter, non-invasive blood pressure was attached to patients. After that intravenous line was secured with 18 or 20 G IV cannula and intravenous fluid was started. In group E epidural catheter was inserted before giving spinal anaesthesia. In group F

femoral nerve catheter was inserted after giving spinal anaesthesia.

In Group E under all aseptic precautions, with patient in sitting position, a skin wheal was raised at L3-L4 interspaces with 4-5 ml 2% Inj Lignocaine. Epidural space was identified by 18 G Touhy needle in midline with a loss of resistance technique and Epidural catheter was inserted such that 4-5 cm of catheter was remaining in epidural space. After insertion of epidural catheter, lumbar puncture was performed with 23 G quincke spinal needle using paramedian approach in same space. 12 to 15 mg injection of 0.5% bupivacaine heavy was given in subarachnoid space after confirmation of free flow of cerebrospinal fluid. Immediately after spinal anaesthesia epidural catheter was fixed in same space.

In Group F peripheral nerve stimulator guided continuous femoral nerve block was given after giving spinal anaesthesia. Spinal anaesthesia was usually given in L3-L4 intervertebral space. 12-15 mg of 0.5% Bupivacaine heavy was injected after free flow of cerebrospinal fluid by 23 G quincke spinal needle.

Using an aseptic technique femoral artery was located immediately caudal to inguinal ligament. An insulated 18 Gauge touhy needle was inserted just lateral to the artery and femoral nerve was located using a peripheral nerve stimulator (Stimuplex HNS11; B Braun, Freiburg, Germany)with quadriceps twitch at < 0.6 mA usually between 0.2 – 0.5 mA. A 20 guage cathether was inserted through touhy needle and tunnelled subcutaneously and advanced 10-15 cm beyond needle tip to bring them out laterally near the respective anterior superior iliac spine.

After giving spinal anaesthesia in both groups level of blockade were confirmed with testing for cold sensation and pin prick and surgery were started. After operation patients was shifted to postoperative care unit (PACU) for postoperative monitoring. In PACU level of blockade was confirmed with testing for cold sensation and pin prick. Injection 0.125% bupivacaine infusion was started at 5 ml per hour in group E via epidural infusion and in group F via femoral catheter when sensory blockade of patient regressed to below T 11 and initial recovery of motor function. Visual Analogue Scale (VAS) scores of both groups were measured in each hour for first 6 hours, every 2 hour after that up to 24 hours and every 4 hour after that up to 48 hours. Injection diclofenac 75 mg intravenous was used as rescue analgesia when VAS scores was more than 5. Incidences of side effects including Hypotension, Nausea and Vomiting were also observed in both groups.

Statistical Analysis

For continuous variables, independent t test, analysis of variance test (ANOVA) and post hoc analysis and for categorical variables, Chi square test or Fischer exact test were adopted. The difference was regarded as statistically significant when the $p<0.05$ and highly significant if $p<0.001$. The difference was regarded as statistically insignificant if $p>0.05$. The statistical software namely INSTAT 6 (Graph Pad software, California, USA), statistical package for social sciences (SPSS) 15.0, were used for the analysis of the data.

OBSERVATIONS AND RESULTS

The results were analyzed using 30 patients each in E and F groups. The analysis of patients' demographics showed that both groups were nearly matched with respect to age, height and weight. Values are expressed as mean ± standard deviation, number of patients. For comparison of VAS score between group E and group F we divide the observations in two time interval before 6 hours and after 6 hrs. ANOVA Test (Analysis of Variance) is applied for comparison.

TABLE 1: Descriptive Statistics of VAS score in Group E and Group F before six hours and after six hours

Descriptive Statistics				
Before 6 Hours and After 6 Hours		Mean	Std. Deviation	N
Before 6 Hours	VAS Score-E	2.54	1.243	180
	VAS Score-F	3.53	1.101	180
	Total	3.03	1.273	360
After 6 Hours	VAS Score-E	2.09	1.179	450
	VAS Score-F	2.06	1.135	450
	Total	2.08	1.157	900
Total	VAS Score-E	2.22	1.214	630
	VAS Score-F	2.48	1.306	630

	Total	2.35	1.267	1260

TABLE 2: ANOVA Test for before 6 hrs and after 6 hrs time interval

Dependent Variable:	VAS_Score	**ANOVA**			
Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	324.183[a]	3	108.061	80.018	.000
Intercept	6711.620	1	6711.620	4969.910	0.000
Before 6 Hours and After 6 Hours	235.887	1	235.887	174.673	.000
Group	58.426	1	58.426	43.264	.000
Before and After 6 Hours* Group	67.467	1	67.467	49.959	.000
Error	1696.167	1256	1.350		
Total	8974.000	1260			
Corrected Total	2020.349	1259			
a. R Squared = .160 (Adjusted R Squared = .158)					

Null Hypothesis H0 – Difference between VAS scores of group E and group F is insignificant. Alternate Hypothesis H1 - Difference between VAS scores of group E and group F is significant.

Calculated p-value is less than 0.05. It rejects null hypothesis and accept alternate hypothesis. Mean of VAS scores in group F (mean 3.53) is greater than group E (mean 2.54) before 6 hrs. So epidural analgesia gives more pain relief than femoral nerve blockade in first 6 hrs.

Now we divide observations in three time interval 1 to 6 hrs, 6 to 24 hrs and 24 to 48 hrs. ANOVA Test is applied for comparison between group E and group F.

TABLE 3: Descriptive statistics of VAS scores in group E and group F in 1 to 6 hrs, 6 to 24 hrs and 24 to 48 hrs

Dependent Variable:	VAS_Score			
Division_in_3_Groups		Mean	Std. Deviation	N
1 To 6 Hours	VAS Score-E	2.54	1.243	180
	VAS Score-F	3.53	1.101	180
	Total	3.03	1.273	360
6 To 24 Hours	VAS Score-E	2.46	1.129	270
	VAS Score-F	2.48	1.093	270
	Total	2.47	1.110	540
24 To 48 Hours	VAS Score-E	1.54	1.032	180
	VAS Score-F	1.42	.871	180
	Total	1.48	.956	360
Total	VAS Score-E	2.22	1.214	630
	VAS Score-F	2.48	1.306	630
	Total	2.35	1.267	1260

TABLE 4: ANOVA Test applied for 1 to 6 hrs, 6 to 24 hrs and 24 to 48 hrs time interval

ANOVA Test

Tests of Between-Subjects Effects					
Dependent Variable:	VAS_Score				
Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	535.746[a]	5	107.149	90.506	.000
Intercept	6590.523	1	6590.523	5566.816	0.000
Division_in_3_Groups	446.323	2	223.162	188.498	.000
Group	26.667	1	26.667	22.525	.000
Division_in_3_Groups * Group	68.594	2	34.297	28.969	.000
Error	1484.604	1254	1.184		
Total	8974.000	1260			
Corrected Total	2020.349	1259			
a. R Squared = .265 (Adjusted R Squared = .262)					

Calculated p-value is less than 0.05. So, null hypothesis is rejected. There is significant difference in VAS scores between group E and group F in three time interval 1 to 6 hrs, 6 to 24 hrs and 24 to 48 hrs. All observations of VAS score of group E and group F are divided into three time interval 1 to 6 hrs (T1), 6 to 24 hrs (T2) and 24 to 48 hrs (T3) for post hoc test. VAS scores of one time interval are compared with VAS scores of other two time interval in post hoc test.

TABLE 5: Tukey HSD Test (Post Hoc Test) in three time interval T1, T2 and T3

(I) Division_in_3_Groups		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1 To 6 Hours(T1)	8 To 24 Hours(T2)	.56*	.074	.000	.39	.74
	28 To 48 Hours(T3)	1.55*	.081	.000	1.36	1.74
6 To 24 Hours(T2)	1 To 6 Hours(T1)	-.56*	.074	.000	-.74	-.39
	28 To 48 Hours(T2)	.99*	.074	.000	.81	1.16
24 To 48 Hours(T3)	1 To 6 Hours(T1)	-1.55*	.081	.000	-1.74	-1.36
	8 To 24 Hours(T2)	-.99*	.074	.000	-1.16	-.81
Based on observed means. The error term is Mean Square (Error) = 1.184.						

The difference is significant at the .05 level. So VAS scores in one time interval is significantly different from other two time intervals.

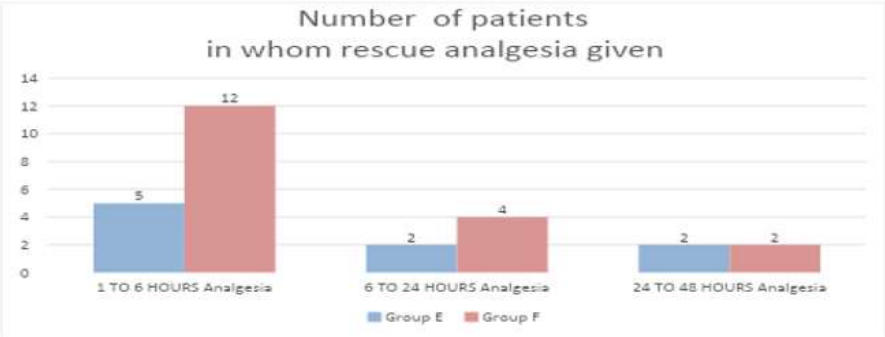

FIGURE 1: COMPARISON OF RESCUE ANALGESIA AT DIFFERENT TIME INTERVAL

TABLE 6: RESCUE ANALGESIA AT 1-6 HRS

Rescue Analgesia_1_To_6_Hours			
	Group		
	E	F	p-value
No	25	18	.045
Yes	5	12	
Total	30	30	

Number of patients requiring rescue analgesia were 5 vs 12 , 2 vs 4 and 2 vs 2 patients during 1-6 hrs , 6-24 hrs and 24-48 hrs in group E and group F respectively. Need of rescue analgesia between group E and group F is statistically significant in first 6 hrs (P = 0.045) while at 6-24 hrs (P = 0.389) and 24-48 hrs (P = 1.00) which is insignificant. Group

F were required more rescue analgesia than group E in first 6 hrs.

Incidence of hypotension, nausea and vomiting were not statistically significant in group E and group F. However side effects were more observed in group E than group F in first 6 hrs.

Cardiac complications were not observed in any group. No postdural puncture headache or residual neurological complications such as numbness, dysthesia, or weakness associated with femoral nerve blockade or combined spinal-epidural blockade were reported until the end of study period. No patients was withdrawn from the study.

DISCUSSION

Effective pain control is a major concern in the postoperative management of knee surgeries. Postoperative pain following total knee replacement directly impacts postoperative physiotherapy and mobilization.[4] Pain is maximum up to 48 hours after surgery.[5] Effective postoperative pain control is important to initiation of physiotherapy and early ambulation, which hastens recovery and reduces hospital length of stay.[6] The difference between VAS scores of group E and group F is significant before 6 hrs and after 6 hrs and also in 1 to 6 hrs, 6 to 24 hrs and 24 to 48 hrs. Mean of VAS scores in group F (mean 3.53) was found greater than group E (mean 2.54) before 6 hrs. But after 6 hrs mean of group E (mean 2.09) was more than group F (mean 2.06). So epidural analgesia gives more pain relief than femoral nerve blockade in first 6 hrs.

Epidural analgesia gives more pain relief than femoral block in 1 to 6 hrs and 6 to 24 hrs while in 24 to 48 hrs femoral block gives more pain relief than epidural analgesia when ANOVA test was applied in three time interval. Need of rescue analgesia between group E and group F is statistically significant in first 6 hrs ($P = 0.045$) while at 6-24 hrs ($P = 0.389$) and 24-48 hrs ($P = 1.00$), it is insignificant. Incidence of hypotension, nausea and vomiting were not statistically significant in group E and group F

Harsha Shanthaanna *et al.*[3] showed that VAS scores were significant high in femoral group at 0-6 hr than epidural group. After 6 hrs both group had similar VAS scores. Sundarathiti P *et al.*[7] found patient satisfaction was greater with the continuous femoral nerve block although postoperative knee rehabilitation and the hospital length of stay were not different.

In contrast to above studies, metaanalysis did by Fowler S J *et al.*[8] showed there was no significant difference in pain scores between epidural and peripheral nerve block at 0-12 h or 12-24 h and 24-48 h.

Some studies suggested that TKR pain relief cannot be relieved by sole femoral block. Due to extensive nerve supply of knee joint additional sciatic block or 3 in 1 block may be used for pain relief after major knee surgery. Anatoli Stay *et al.*[13] found that pain relief after total knee arthroplasty immediately after surgery and on the first postoperative day was significantly superior in patients who received multiple block (femoral, sciatic, obturator, and lateral femoral cutaneous nerve) preoperatively than femoral nerve block alone.

In our study rescue analgesia was given when VAS score was more than 5. Injection diclofenac 75 mg intravenous was used as rescue analgesia. Need of rescue analgesia was significant in 0-6 hrs in femoral group. Harsha Shanthaanna *et al.* (3) showed use of rescue analgesic was higher in the femoral group in first 6 hrs. After the first 6 h, use of rescue analgesic was nearly the same in both the groups.

Sundarathiti P *et al.*[7] found injection tramadol intravenous requirement were significantly greater in continuous femoral group than the continuous epidural group at postoperative 6 hr and 12 hr. Capdevila X *et al.*[10] studied effects of the perioperative analgesia technique on surgical outcome and duration of rehabilitation in patients following knee surgeries. The continuous epidural infusion and continuous femoral block groups showed significant lower VAS scores at rest and during continuous passive motion compared with patient controlled analgesia.

Allen HW *et al.*[9] concluded that Rescue analgesia drug in form of opioid use was decreased by approximately 50% in the peripheral nerve block groups until the second postoperative day. M Kaya *et al.*[12] studied the comparison of the analgesic efficacy, early rehabilitation and the side effects of continuous epidural analgesia with continuous femoral analgesia after total knee arthroplasty. There were no statistically significant differences between groups with regard to side effects like nausea, vomiting, hypotension, headache, backache and urinary retention. Although a significant difference was not shown in this study, the incidence of

nausea-vomiting and urinary retention was higher in epidural group.

Harsha Shanthaanna *et al.*[3] found that side-effects were twice as common in the epidural group than in the femoral study group. The differences were not statistically significant.

Sundarathiti P *et al.*[7] Patients in the epidural group experienced more dizziness, pruritus, nausea and vomiting than the continuous femoral group and it was significant.

FNB both single injection, intermittent or continuous modalities, has been shown to provide effective postoperative analgesia. The purported advantage of FNB include unilateral analgesia, decreased incidences of side effects related to epidural analgesia. Additionally, the key effect of FNB on postoperative pain may be due to its ability to reduce pain from significant quadriceps spasm occurring from TKR

CONCLUSION

Analysis revealed that there was significant difference observed in VAS scores between both groups. When ANOVA test was applied in two time interval (first 6 hrs and after 6 hrs) epidural analgesia was found to be superior than continuous femoral blockade in pain relief in first 6 hrs. In 6 to 48 hrs time period femoral nerve block was better than epidural analgesia. In three time interval (1 to 6 hrs, 6 to 24 hrs & 24 to 48 hrs) ANOVA test epidural analgesia was found better in 1 to 6 hrs, 6 to 24 hrs, & in 24 to 48 hrs femoral nerve block was found better than epidural analgesia. Need of rescue analgesia were more in patient of femoral nerve block in first six hours. Although side effects were found to be higher in epidural group but no statistically significant difference were observed in side effects in both groups.

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