Original Article

Indian Journal of Anaesthesia and Analgesia
2017, 4 (3, Part-II), 794-800
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.4317.40

Comparison between Ultrasound Guided Continuous Femoral Nerve Block with Continuous Epidural Analgesia for Post Operative Pain Relief in Major Knee Surgeries

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Abstract

Introduction: 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 utilized, including continuous infusion techniques. With the use of ultrasound, the needle and catheter placement can be done accurately under real-time guidance. *Materials and Methods:* It is a randomized controlled study. The study was approved by institutional ethical committee and consent was obtained from the patients. 60 consecutive patients who are posted for the major knee surgeries selected according to inclusion and exclusion criteria and randomized in to two groups. *Group I CEA* (continuous epidural analgesia) had an epidural catheter using 16 or 18 G epidural needle inserted at L2-L3 interspace whereas in *Group II CFB* (continuous femoral block), femoral catheters was done using ultrasound guidance. VAS scores (0-10) for pain, the use of rescue analgesic and side effects like hypotension, vomiting, itching and urinary retention were recorded. *Results:* There is no significant difference in the age distribution between the two groups. In this study we did not notice any significant difference in the pain level after 6hrs of the post op period between the two groups as evident in the VAS scores. There was a significant fall in the BP in Group I compared to Group II during most of the hours of monitoring. Incidence of vomiting, bradycardia and urinary retention are more in Group I whereas patient acceptance is more with Group II. *Conclusion:* Within the limitations of this study, we conclude that CFB using ultrasound guidance provides equivalent analgesia with decreased exposure to potentially significant neurological complications.

Keywords: Continuous Femoral Block; Continuous Epidural Analgesia; TKR; VAS Score.

Introduction

Peripheral nerve block, in which local Anaesthetic is injected into a peripheral nerve, may provide superior pain relief when used as part of a balanced analgesia. Femoral nerve block is a basic nerve block technique that is easy to master, carries a low risk of complications and has a significant clinical applicability for surgical anesthesia and postoperative pain management.

This block can be done with the help of ultrasound, nerve stimulator or as a blind technique. The use of ultrasound increases the safety and success rate of the femoral block. This block is well suited for postoperative pain management after femur and knee surgery & surgical anesthesia of quadriceps muscle biopsy, knee arthroscopy, quadriceps tendon repair.

When combined with the block of the sciatic nerve, anesthesia of the almost entire lower extremity from the mid-thigh level can be achieved. The success rate of this block for surgery is very high, nearing 95% when it is done with the help of ultrasound as long as the scope of surgery does not extend beyond the area of coverage of the femoral nerve. By placing a

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Received on 25.05.2017, **Accepted on** 13.06.2017

catheter into the femoral nerve sheath continuous nerve block is achieved. In addition to femoral nerve, obturator nerve and lateral cutaneous nerve of the thigh are also blocked [1].

A controlled study to compare the efficacy and the Incidence of complications between ultrasound guided continuous femoral Nerve block and continuous epidural analgesia for postoperative pain relief following major knee surgeries.

Post operative analgesia in major knee surgeries patients were compared between continuous epidural analgesia and continuous femoral block technique. VAS scores and use of rescue analgesic were used as parameters. Secondary aims included comparison of rehabilitation scores and side effects in the form of hypotension, vomiting, itching and urinary retention.

Materials and Methods

It is a randomized controlled study. The study was approved by institutional ethical committee and consent was obtained from the patients.

Inclusion Criteria

Elective patients posted for major knee surgeries, patient ability to give consent and willingness to participate in the study, ASA 1-2 category and patients in the age group 18-65 yrs was included in this study.

Exclusion Criteria

Patients who are inability to give consent for language or cognitive reasons, patient refusal, psychiatric illness, contra indication to femoral nerve block (infection overlying the injection site or previous femoro popliteal bypass surgery), central neuraxial blockade (patient refusal, plate let count less than 1 lakh) were excluded.

Sterile standard anesthesia tray prepared with the following equipments: Sterile towels and 4×4 gauze pack, 20 ml syringe, local anesthetics 0.125% bupivacaine, fentanyl and 2% lignocaine, Sterile gloves marking pen, surface electrode, One 2 cc 25 gauge needle for skin infiltration, 13cm long, short bevel, insulated stimulating needle (B BRAUN contiplex d type), 16 or 18 gauge epidural needle with catheter, ultrasonogram machine, peripheral nerve stimulator and elastomeric or infusion pump used in this study.

Methodology

Institutional approval taken. Patients were advised over night fasting. 60 consecutive patients who are posted for the major knee surgeries randomized in to two groups. The case was done under general anaesthesia or sub arachnoid block. All patients assigned numbers 1-60.

Group I CEA (continuous epidural analgesia): CEA group had an epidural catheter using 16 or 18 G Epidural needle inserted at L2-L3 interspace before spinal anaesthesia or general anaesthesia such that 4cms of catheter in the epidural space.

Group II CFB (continuous femoral block): Insertion of femoral catheters was done using ultrasound guidance 13 cm 18G CONTIPLEX D system was introduced by an in plane approach using ultrasound at the end of surgery such that 4cms of the catheter is within or near femoral nerve sheath.

At the end of surgery BOTH GROUPS received 12 ml of 0.125% bupivacaine mixed with 2mcg/ml fentanyl as given before shifting to recovery. Level of blockade and analgesia was confirmed with testing for cold sensation and pinprick. Post-operative regimen for analgesia included continuous infiltration of mixture of 0.125% bupivacaine with 2mcg/ml of fentanyl, using elastomeric pump or infusion pump. The initial rate of infusion was set at 7ml/hr in both groups, which was then titrated appropriate to patient's level of pain by the end of every 12 hrs after blockade.

The following parameters are assessed;

Primary outcome measures were;

VAS scores (0-10) for pain and the use of rescue analgesic in the form of iv tramadol 100 mg IM .VAS scores at rest were recorded each hour for the first 6hr and every 2 hr up to 24 hr and every 4th hrly up to 48 hrs. The first 6 hrs were considered as the intensity of pain is supposed to be highest and often requires increased titration of analgesics.

Secondary outcome measures included;

Side-effects in the form of nausea vomiting, hypotension, difficulty in passing urine requiring catheterization and itching and rehabilitation score in the form of (ROM) range of movements at the knee joint and ease of physiotherapy in the post op period is monitored.

All patients premedicated with Inj. Fentanyl 1μg/kg and Glycopyrolate I.M 30 mts before the procedure. Base line parameters were recorded. An

18 gauge needle was inserted in the fore arm and crystalloid infusion started. Either GA or SPINAL anaesthesia is performed as suitable for the patient. Intra op patient were sedated with inj midazolam 0.02 to 0.03mg/kg.

Post-Operative Care

All the patients were shifted to ICU. Patients monitored for pain relief with VAS scores, complication like hypotension, Bradycardia, vomiting and urinary retention. All patients who develop break through pain (VAS score more than 3) will be supplemented with injection tramadol 100mg. Patients developing bradycardia were treated with Inj. Atropine 0.6mg and patients who had hypotension will be treated with Inj. Ephedrine 6mg and I.V. fluids. Patients developing vomiting were treated with Inj.Ondansetron 8.0 mg and I.V. fluids. Patients who developed urinary retention were catheterized with foley catheter of appropriate size.

The statistical software, namely statistical analysis system (SAS) 9.2, statistical package for social sciences (SPSS) 15.0, Stata (Data Analysis and Statistical Software) were used. Student t test and chi square test were used. P value of less than 0.05 is significant.

Results

The analysis of patient demographics has shown that the groups were matched with respect to age and sex. There is no significant difference between the groups.

VAS scores shows that femoral group has high VAS score up to 6 hrs in the immediate post op, after which the trend declines and both femoral and epidural group has near similar VAS scores, the need of rescue analgesic was higher in the femoral group, almost 8 patients needed pain relief or break through pain in the first 6 hrs of post op whereas only two patients only needed rescue analgesic in the epidural group. Tramadol 100 mg I.M given as rescue analgesic.

Table 1: Demographic data

S. No	Age Group	Group I	Group II	Total
1	20-30yrs	5 (16.7%)	1(%)	6(10%)
2	31- 40 yrs	7(23.3%)	5(16.7%)	12(20%)
3	41- 50 yrs	6(20%)	11(36.7%)	17(28.3%)
4	51-60 yrs	8(26.7%)	8(26.7%)	16(26.7%)
5	61-70 yrs	4(13.3%)	5(16.7%)	9(15%)
6	Total	30(100%)	30(100%)	60(100%)

Table 2: VAS score analysis between two groups

S. No.	Vas Score	Mean	SD	Mean	SD	"P" Value
1	1 HOUR	3.5	0.78	5.43	0.97	<0.001
2	2 HOURS	3.1	0.85	4.73	0.94	<0.001
3	3 HOURS	2.53	0.63	4.67	1.47	<0.001
4	4 HOURS	2.27	0.69	4.23	1.07	<0.001
5	6 HOURS	2.6	0.62	3.93	1.02	<0.001
6	12 HOURS	2.4	0.56	2.63	0.56	0.112
7	18 HOURS	2.1	0.71	2.37	0.62	0.126
8	24 HOURS	1.8	0.55	1.93	0.45	0.309
9	36 HOURS	1.53	0.51	1.33	0.48	0.122
10	48 HOURS	1.07	0.25	1.1	0.31	0.647

Table 3: Systolic BP analysis between two groups

S. No	Systolic BP	Mean	SD	Mean	SD	"P" Value
1	1 HOUR	120.1	11.47	124.73	13.5	0.157
2	2 HOURS	112.6	22.3	131.07	14.58	<0.001
3	3 HOURS	109.6	24.75	134.87	14.61	<0.001
4	4 HOURS	105.73	24.13	134.33	14.48	<0.001
5	6 HOURS	110.33	18.01	130.6	13.08	<0.001
6	12 HOURS	118.2	11.08	125.93	7.85	0.003
7	18 HOURS	117.57	8.53	123.93	6.56	0.002
8	24 HOURS	119.7	9.29	119.33	7.53	0.867
9	36 HOURS	120.57	5.63	118.5	6.13	0.082
10	48 HOURS	118.67	5.27	116.33	6.79	0.143

Table 4: Diastolic BP analysis between two groups

S. No.	Diastolic	Mean	SD	Mean	SD	"P" Value
1	1 HOUR	75.3	11.14	81.1	10.67	0.044
2	2 HOURS	74.23	14.51	86	11.83	0.001
3	3 HOURS	70.5	14.84	87.53	11.86	<0.001
4	4 HOURS	67.43	17.13	87	11.42	<0.001
5	6 HOURS	69.23	12.74	83.93	10.86	<0.001
6	12 HOURS	75.57	9.87	80.6	9.47	0.048
7	18 HOURS	70.27	8.63	79.87	7.74	<0.001
8	24 HOURS	72.33	8.45	76.2	9.83	0.108
9	36 HOURS	72.97	10.05	75	6.23	0.35
10	48 HOURS	73.4	9.88	72.1	16.04	0.707

Table 5: Pulse Rate analysis between two groups

Pulse Rate	Mean	SD	Mean	SD	"P" Value
1 HOUR	85.8	9.52	89.37	12.06	0.208
2 HOURS	87.53	15.69	95.13	11.56	0.037
3 HOURS	80.13	16.35	98.53	12.051	<0.001
4 HOURS	81.47	19.66	98.37	10.27	<0.001
6 HOURS	82.8	16.99	96.43	6.33	<0.001
12 HOURS	84.37	9.23	91.5	5.95	<0.001
18 HOURS	85.4	8.63	87.47	6.25	0.292
24 HOURS	81.57	10.25	86.3	7.07	0.042
36 HOURS	82.6	7.68	83.87	7.56	0.522
48 HOURS	78.77	7.52	80.66	7.12	0.319

Table 6: Hypotension, bradycardia, vomiting, urinary retension and patient acceptance analysis between two groups

S. No.	Variable	Group I	Group II
1	No Hypertension	30(100%)	20(66.7%)
	Hypertension	0	10(33.3%)
2	No Bradycardia	24(80%)	30(100%)
	Bradycardia	6(20%)	0%
3	No Vomiting	25(83.3%)	29(96.6%)
	Vomiting	5(16.6%)	1(3.33%)
4	No Urinary Retention	25(83.3%)	30(100%)
	Urinary Retention	5(16.6%)	0%
5	Patient acceptance		
	Very satisfying	3(10%)	18(60%)
	Satisfying	15(50%)	10(33.3%)
	Not Satisfying	12(40%)	2(6.6%)

VAS score analysis gives an idea that comparing the both groups VAS score is very significant difference in the initial 6 hrs immediate post op where the continuous EPIDURAL group is found to have better pain relief comparing the continuous femoral group, after 6-48 hrs the pain relief in both group is comparable or similar or in significant by probability.

There is a significant increase in systolic BP in the femoral block group comparing the epidural group for the 18 hrs following the block and continuous infusion

There was a significant difference in the BP during the early 18 hours of study following which there is no much difference.

There is a significant difference in the pulse rate between the two groups from the 2nd hour up to 12th hour compared over a period of 48 hours.

The common side effects such as hypotension, bradycardia, urinary retention, utricaria and vomiting are found to be higher in epidural group than in the femoral group.

Hypotension is evident that none of the patients in group one developed hypotension where as 8 patients in group 2 developed hypertension. There was a significant increase in the incidence of hypotension in group 2. Hypotension was treated with bolus of Inj .Ephedrine 6mg I.V, I.V fluids.

Bradycardia is observed in 6 patients in epidural where a pulse rate is below 60 for more than 15 mins considered or treated with Inj. Atropine 0.6 mg I.V, no

case has an intractable bradycardia.

Vomiting is found in 5 patients in epidural group is seen treated with ondansetron and one patient in femoral group had vomiting.

Urinary Retention is seen in 5 patients in epidural group and no patient in femoral group had urinary retention, treated with indwelling urinary catheter

Rehabilitation or post op physiotherapy is assessed by flexion extension and the range of movements which was found to be similar in both groups.

NO patients had difficulty in threading the catheter, no infection associated with catheter. Pruritis is there for 4 patients in epidural group it doesn't need any treatment just assuring the patient is needed.

Patient acceptance is high with group II as evident from the chi-square analysis.

Disscussion

The aim of postoperative pain treatment is to provide subjective comfort in addition to inhibiting trauma-induced nociceptive impulses in order to blunt autonomic and somatic reflex responses to pain and subsequently to enhance restoration of function by allowing the patient to breathe, cough and move more easily. Unrelieved pain after surgery is often unhealthy; fortunately, it is preventable or controllable in an overwhelming majority of cases. Pain control may have a further benefit of improving clinical outcome by reducing the incidence of postoperative complications such as:

- Myocardial infarction or ischemia
- Risk of tachycardia and dysrhythmia
- Impaired wound healing
- Risk of atelectasis
- Thromboembolic events
- Peripheral vasoconstriction
- Metabolic acidosis.

Direct injection of local analgesic drugs close to peripheral nerves, major nerve trunks or nerve roots produces analgesia by blocking conduction of afferent impulses.

Epidural analgesia is a useful technique for the relief of postoperative pain because a catheter can be used to maintain analgesia in the postoperative period. There are numerous studies to compare peripheral nerve block with epidural analgesia for post of pain relief, the results of which were conflicting. In some of the studies, peripheral nerve block was the preferred technique for knee surgeries.

Earlier studies comparing two techniques for total knee replacement show consistent results as with present study, one of the largest study, Barrington et al[2] showed equivalent analgesia between two techniques. The decreased efficacy of CFB compared with CEA in the first 6 hrs may be related to sciatic component for knee innervations.

There are nearly equal numbers of studies arguing about sufficient and insufficient blockade with femoral block alone. The post operative pain relief was given for a period of 48 hours. During the study the pain scores supplemental analgesia satisfaction score and side effects like vomiting, nausea, pruritus, hypotension, urinary retention were compared between the two groups. The rehabilitation score and Post operative pain relief was comparable in both the groups at all times. In the study, continuous femoral analgesia was associated with a significantly less frequent incidence of nausea, vomiting, urinary retention and hypotension when compared with a continuous epidural analgesia. The unilateral blockade achieved by CFB encourages early mobilization apart from passive and active mobilization of the limb for physiotherapy. Patients having TKR are mostly above 50 years and may suffer from cardiovascular disease and taking anticoagulants, CFB doesn't need withholding these medications and lesser risk of altering the physiological profile also less impact on cardiovascular system comparing CEA. The incident of side effects was 23.5% in continuous femoral group whereas it was 71.9% with continuous epidural. The satisfaction score was significantly higher in continuous femoral group. (About 87±14) in compared with continuous epidural group (about 81 or ± 14).

Our aim is to compare the efficacy of continuous femoral nerve block to epidural analgesia for post-operative pain relief in major knee surgeries.

In our study, it is evident from the statistics that there is no significant difference in the age distribution between the two groups.

Pain

The site of skin incision is in the medial or lateral aspect of knee joint exposing the whole knee joint. The cutaneous distribution of this area is covered by the femoral, obturator and lateral cutaneous nerve of the thigh. The Fascia lata and the Vastus muscles which are retracted during the procedure were supplied by the femoral nerve. A small part of the

posterior aspect of the knee joint supplied by tibial nerve.

The Femoral nerve block provided effective post operative analgesia in patients with supracondylar fracture of femur, knee arthroplasty for ACL reconstruction, meniscial tear and total knee replacement.

In the earlier studies by Singelyn et al [3], the pain relief was comparable8 in both a groups but Cuvillon et.al [4], in his study showed that Continuous femoral nerve block provided limited pain relief after hip fracture did not reduced side effects and induced an expensive cost.

In our study we did notice significant difference in the pain level between the two groups as evident in the VAS scores in the initial 6hrs of post operative period; however after 6hrsto 48 hrs the VAS scores of the both groups are same and insignificant. However 2 patients in group 1 and 3 patients in group 2 developed breaks through pain defined as VAS scale 3 and above according to universal pain measurement tool. The pain relief was comparable throughout the 24 hour period of study as evident from the p value. The patients in both the groups who developed break through pain were supplemented with Inj. tramadol 100mg IM.

Hypotension and Bradycardia

The sympathectomy produced by central neuraxial anesthesia induces hemodynamic changes. Hypotension and bradycardia are the most common side effects seen with sympathetic denervation. Risk factors associated with hypotension include hypovolemia, preoperative hypertension, high sensory block height, age older than 40 years, obesity, combined general and spinal anesthesia, history of hypertension, elevated BMI, high level of sensory block height, and urgency of surgery all increase the likelihood of hypotension after central neuraxial anesthesia.

The cause of hypotension includes paralysis of the sympathetic vasoconstrictor fibers, loss of the milking action of peripheral muscles of lower limb and blockade of cardio accelerator fibers in higher block. The causes of bradycardia include blockade of cardio accelerator fibers in higher block, the presence of Bezold Jarisch Reflex and Bainbridge reflex.

The Bezold–Jarisch reflex (BJR) has been implicated as a cause of bradycardia, hypotension after central neuraxial anesthesia, The BJR is a cardio-inhibitory reflex and consists of the triad of symptoms, bradycardia, hypotension and cardiovascular collapse.

There was a significant fall in the BP in Group 1 compared to Group 2 during most of the hours of monitoring as evident from the p value. None of the patients in Group 2 had a fall in BP.

The fall in BP was more pronounced at the beginning of the epidural analgesia as evident from the study. Although most have a fall of more than 20% in systolic BP which is the range in which the BP is maintained during anesthesia, ten patients out of 30 patients had a fall in BP of systolic less than 90 requiring ephedrine 6 mg increments, of the ten patients 3 patients had more than one episode requiring more ephedrine supplements.

Bradycardia and asystole can occur unexpectedly during neuraxial anesthesia. Moderate or severe bradycardia may occur at any time during neuraxial anesthesia, regardless of the duration of anesthesia. Low baseline heart rate increases the risk for bradycardia.

The incidence of bradycardia is more pronounced in group 1, whereas none of the patients in group 2 developed Brady cardia. The patients who developed Bradycardia were treated with Inj. Atropine 0.6mg. I.V.

Vomiting

It is a common complication associated with hypotension during anesthesia. Hypotension is a common occurrence during neuraxial anesthesia. Low blood pressure may lead to brain stem ischemia, which is thought to activate the circulatory, respiratory, and vomiting centers grouped together in the medulla. Hypotension also leads to gut ischemia and the release of emetogenic substances (*e.g.*, serotonin) from the intestines. Neuraxial anesthesia also changes the function of the gastrointestinal tract. Sympathetic blockade by local anesthetics creates unopposed vagal action, resulting in gastrointestinal hyperactivity.

Lanz et. al [5] in their study showed that the incidence of vomiting during epidural anesthesia was 29% in orthopedic procedures. There was a significant difference in the incidence of vomiting between the two groups as evident from the p value. Five patients out of group 2 who developed hypotension had vomiting (incidence 16%). The vomiting occurred during the episode of hypotension. None of the patients in group 1 had vomiting.

Urinary Retention

Urinary retention is common after anesthesia and surgery, reported incidence of between 5% and 70%. In the study by Syngelyn et al [3], the incidence of urinary retention was 13% after continuous femoral nerve block. In the study by Capdevila et al [6], no patient developed urinary retention after continuous femoral nerve block. In our study, 5 patients belonging to Group 1 had urinary retention, requiring catheterization. None of the patients in Group 2 developed urinary retention.

Patient acceptance was more with group 2 compared with group 1, and it was found to clinically significant from the p value. The most common reason found for the decreased acceptance in group I was that most patients don't like to have a catheter at the back even though the pain relief was good. Also the Group 1 patients due to their early femoral nerve block could be easily positioned for spinal anesthesia than Group 2.

Conclusion

To conclude that CFB using ultrasound guidance provides equivalent analgesia with decreased exposure to potentially significant neurological complications and complications of central neuraxial blockade, the inferior analgesia in the initial period may be supplemented by a single shot sciatic nerve block or analgesic.

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