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Original Research Article

Evaluation of Analgesic Effect of 0.25% Bupivacaine versus 0.25% Ropivacaine in "3 in 1" Femoral Nerve Block for Knee Surgeries

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Conflict of interest: Nil

Abstract:

Background: Total knee replacement (TKR) and other knee surgeries are amongst the most painful orthopedic procedure, mandating effective postoperative pain management. Ropivacaine is a New Local anesthetic Agent with Minimal CVS Toxicity. The primary aim of is to study effect of 3 in 1 femoral nerve block for providing pain relief with Ropivacaine (0.25%). Secondary aim is to compare the effect of Ropivacaine 0.25% with Bupivacaine (0.25%) in providing 3 in 1 femoral nerve block.

Methods: A prospective randomised study was carried out in 36 ASA I & II patients undergoing knee surgery surgeries were divided into two groups of 18. Group (R) received Ropivacaine (0.25%) 40 ml. Group (B) received Bupivacaine (0.25%) 40 ml.

Results: Demographic and hemodynamic parameters were statistically not significant. The duration of analgesia is longer with Group R (7.83±0.98) than Group B (6.33±0.76) ($p<0.001$) which is statistically very significant. Observing VAS score Group R shows significantly ($p<0.05$) lower values than Group B for at 4^{th} to 8^{th} hours & than at 24^{th} hour. Ropivacaine is significantly more effective in postoperative duration of pain. No Adverse events noted in both groups.

Conclusion: Postoperative 3 in 1 femoral nerve block with 0.25% ropivacaine is effective in providing pain relief and duration of analgesia is more in comparison to 0.25% bupivacaine.

Keywords: Femoral Nerve Block, Postoperative Analgesia, Ropivacaine.

Introduction

Total knee replacement (TKR) and other knee surgeries are amongst the most painful orthopedic procedure, mandating effective postoperative pain management. Uncontrolled pain result in endocrine, metabolic and inflammatory response which have adverse effects on various organ functions. This is especially demanded in elderly which limits poor physiological reserve. Poorly treated pain can also have negative impact on recovery, especially owing to disruption during physiotherapy resulting in stiffness of joints and slow progress in mobility. Current techniques for providing post operative analgesia are centered on administration of systemic analgesics: opioids and nonsteroidal anti-inflammatory drugs via various routes. Patient controlled intravenous opioids, epidural analgesia with opioids, peripheral nerve blocks and nonpharmacological methods like Tens Hypnosis etc. Use of opioid is associated with side effects such as nausea, vomiting, urinary retention, respiratory depression. Chronic use of NSAIDS are associated with nausea, vomiting, epigastric pain, gastric ulceration, gastric bleeding, agranulocytosis and anaemia. Moreover, complications due to these drugs and techniques necessitate close monitoring and therapeutic intervention whenever necessary. The major site of pain control was thought to be brain until, Koller's daring introduction of local anesthetic blockade on his eye in 1884 and after successful demonstration of femoral nerve block by Winnie in 1973. After this, peripheral nerves became major option for analgesia. Regional analgesic technique forms choice for providing pain relief as the techniques are easy to perform, comparatively safe, free from systemic side effects, very effective, and can provide long duration of pain relief .3 in 1 femoral block have been shown to provide effective post operative analgesia following lower limb surgeries. The inguinal perivascular technique of lumbar plexus block commonly known as the 3 in 1 femoral block, was described by Winnie et al in 1973.Singelyn and colleagues had shown that a

continuous 3 in 1 femoral nerve block using Bupivacaine decrease pain score after TKR and was associated with fewer side effect than after continuous epidural analgesia. James E Paul & his associates carried out meta-analysis of RCT on "FNB improve analgesia outcome after TKR" from this metaanalysis of 23 studies single shot FNB improve analgesia & reduce morphine dose compare with i.v. PCA.T hese studies did not demanded further improvement with continuous compared to single short FNB. Regional blocks remain a well-accepted component of comprehensive anesthesia care. Their role has expanded from operating suite into the arena of postoperative and chronic pain management. With appropriate selection and sedation, these techniques can be used in all age groups. Skillful application of these blocks broadens the anesthesiologist's range of options in providing optimal anesthetic care. Bupivacaine is the most commonly used local anesthetic in femoral nerve block, however, the onset of action is delayed, and Bupivacaine has been associated with high rate of cardiac and local toxicity. Based on investigations of etiological mechanisms of local anesthetic induced cardio toxicity, the search for less toxic alternatives to Bupivacaine has concentrated on amide-linked agents comprised of a single enantiomer. Unlike Bupivacaine, which is a racemate, Ropivacaine is pure S(-)-enantiomer developed for the purposes of reducing the potential toxicity and improving the relative sensory and motor block profiles. Thus, we decided to study this new compound to evaluate efficacy and to compare with commonly used compound that is Bupivacaine and ropivacaine via single shot femoral nerve plexus block.

Material and Methods

A prospective, randomized single blind study of 36 patients posted for orthopedic knee surgeries was conducted at Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar during a period from September 2020 to March 2021. In all the cases a detailed history, physical examination and investigations were done before their enrolment in the study.

Sample Size and Study Population: Using Acastat statistical software, the mean and standard deviation for the parameter "duration of analgesia" was counted. Further these values along with α error of 0.2 and β error of 0.05 were used to compare the groups: group R and group B. Thus, a comparison of two groups, using Medcalc software helped in deriving at a sample size of 18 per group. Patients with age group –18 to 80 years either sex, ASA – I/II, Planned/Emergency Surgery and give informed consent were included in this study.

Patients with hypersensitivity to local anaesthetic drug, bleeding disorders/patient on Anticoagulant, CVS, R/S, renal, liver disease, pregnant, neurological disorders, nerve palsy and neuromuscular disease cases were excluded in this study.

36 patients were enrolled in this study which were equally divided into two study groups in 1: 1 ratio by closed envelope technique Group R – "3 in 1" FNB with Inj. Ropivacaine (0.25%) – 40ml (18 Patients) Group B – "3 in 1" FNB with Inj. Bupivacaine (0.25%) – 40 ml (18 patients)After getting written informed consent, patients were blinded. (They did not know into which group they were being allotted.)

The block was given as per the technique advocated by Winnie in 1973. Patient positioning: The patient was placed in supine position with legs extended. In obese patient, pillow was placed beneath the hip, facilitating palpation of femoral artery. Landmarks: Femoral crease, femoral artery. Needle insertion site is labeled immediately (1 cm) lateral to the pulsation of femoral artery with the marking pen.

Procedure:

- 3 in 1 femoral nerve block is essentially a modification of femoral nerve block.

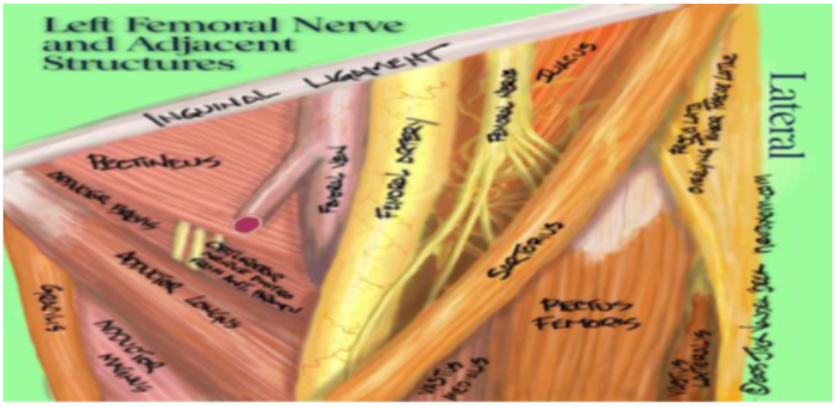

Figure 1:

- A line drawn between anterior superior iliac spine & pubic tubercle marks the position of inguinal ligament. The femoral artery is palpated as it passes behind the midpoint of inguinal ligament. The needle is inserted just below the ligament, 1 cm lateral to the artery parallel with the course of nerve but inclined superiorly at an angle of 45°.

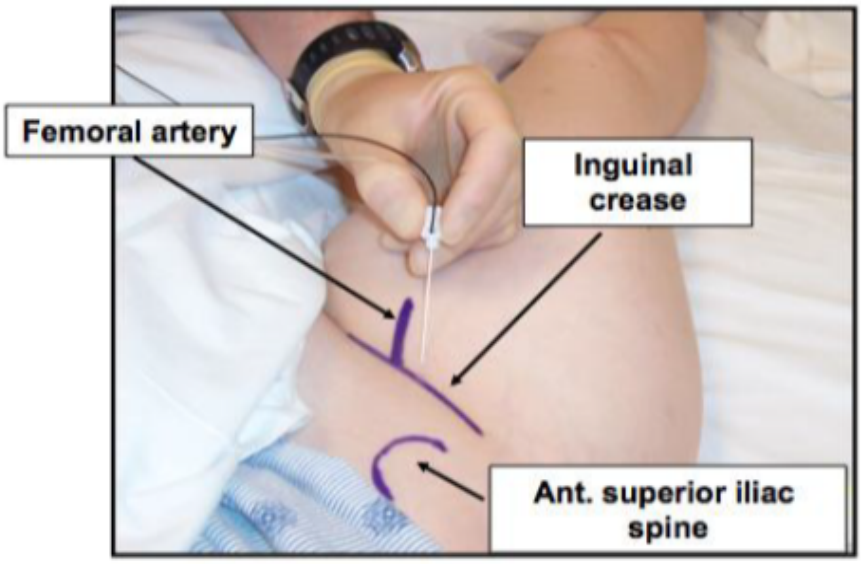

Figure 2:

A click is felt as the needle passes through fascialata and it should be advanced with the gentle probing motion until a second click is noted as the needle penetrates fascia iliaca. The needle advanced further until parasthesia is obtained**.** When nerve stimulator is used, quadriceps contraction with patellar tap should be elicited with the current of 0.5mA or less, after which needle should be held firmly to prevent it from moving. Firm pressure is applied distal to the needle with the thumb in order to prevent peripheral spread, and the local anaesthetic is injected after an aspiration test. It is best if an assistant holds the syringe & injects drug while the anaesthetist holds the needle with one hand & presses below it with other. Thus, three nerves i.e femoral, obturator and lateral femorocutaneus nerve are block by this method. Pulse rate, Blood pressure, Respiratory rate and oxygen saturation (SpO2) are monitored regularly before giving the block, 5 minutes after the block then every 5 minutes till 15 minutes and every 15 minutes till the 1hour and then every hourly up to 4 hour followed by every 2 hourly up to 12 hour and then at 24 hour after giving block.

In the post- operative period, patients were observed at every 5 minutes up to 15 minutes till 1 hour, then hourly up to 4 hour followed by every 2 hourly up to 12 hour and then at 24 hour after giving block. The post-operative pain relief was assessed by using 10-point visual analogue scale (VAS) which is the most commonly used method of assessing intensity of acute pain and its relief. VAS is a 10 cm long scale with gradation at every 1 cm. from 0 to 10. Score 0 on this scale denotes no pain while score 10 denotes the most excruciating pain one can have. The patients were explained about this scoring system and were asked to make a vertical mark on the scale which reflected the intensity of pain, which they experienced at that time. The duration of effective analgesia or pain free interval was counted from time of giving block to when VAS score is more than 4. The rescue analgesia was given in the form of Inj. Diclofenac Sodium 1.5 mg/kg intramuscularly when VAS score was noted >4.

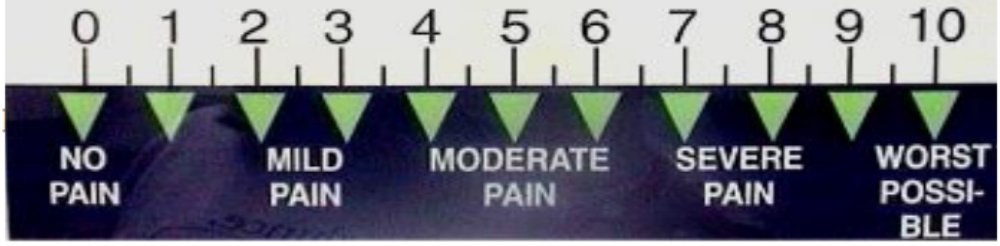

Figure 3:

The duration of effective analgesia or pain free interval was counted from time of giving block to when VAS score is more than 4. The rescue analgesia was given in the form of Inj. Diclofenac Sodium 1.5 mg/kg intramuscularly when VAS score was noted > 4.

- "P" values < 0.05 were taken as statistically significant
- "P" values < 0.001 were taken as highly significant.
- "P" values > 0.05 were taken as statistically not significant

Results and Discussion

It was a prospective, randomised clinical study of 36 patients of either sex of ASA grade I and II undergoing elective or emergency Knee surgery. Group R (n=18) patients received Inj. Ropivacaine 0.25% 40 ml. Group B (n=18) patients received Inj. Bupivacaine 0. 25% 40 ml. All the qualitative and quantitative data were analyzed by using chi square test and unpaired t test respectively. Results were expressed as Mean ±SD. "P" value < 0.05 was taken as statistically significant and values < 0.001 were taken as highly significant. The number of patients in either group were 18. The mean age of patients was 37.30±12.44 years in Group R and 39.70±12.88 years in Group B (P=NS). The ratio of Male to Female was 4:1 in Group R and 2.25:1 in Group B (P=NS). The mean weight of patients was 56.61±4.22Kg in Group R and 56.33±3.75kg in Group B (P=NS). Thus, both the groups are comparable to each other without any statistical difference. Total 16.6 % of patients in Group R and 11.11% in Group B were of ASA I while rest of the most patients were of ASA II (P=NS). Thus, both the groups are comparable without any statistical difference. Total 12(66.66%) surgeries in group-R and 11(61.11%) surgeries in group-B were elective surgeries while remaining were emergency surgeries. Thus, both groups are comparable without any statistical difference. The mean Duration of Surgery was 100±18.62 minutes in Group R and 99.44± 20.99 minutes in Group B (P=NS) and so was comparable amongst both the groups without any statistical difference. Majority of surgeries in both the groups was for Patella tension band wiring (TBW) and other surgeries are open reduction and plating, total knee replacement, external fixation over knee and arthroscopy. There is no any statistical difference in mean arterial pulse rate and Blood pressure in between the two groups.

Table 1: Comparative vas score in between two groups

Timein Hours	Group R	Group B	Pvalue
4hours		2.38±0.77	P<0.05
5hours	0.83±0.92	2.38±0.77	P<0.05
6hours	2.05±1.11	3.33±0.76	P<0.05
7hours	3.0±0.97	4.0±0.00	P<0.05
8hours	3.88±0.32	4.22±0.54	P<0.05
10hours	4.16±0.15	3.77±1.3 after rescue analgesia	P>0.05
12hours	3.77±0.87after rescue analgesia	3.5±1.09	P>0.05
24hours	3.66±0.76	2.94±1.21	P<0.05

Above table shows comparative vas score in between ropivacaine and bupivacaine. Table shows that patient VAS score started at 5th hour in Group R and 4th hour in Group B. The average VAS at 4th, 5th, 6th, 7th, 8th and 24th hour in between both the group when compare, shows there is statically significant difference (p<0.05).Patient has started mild pain at 4th hour after giving block in Group B and at 5th hour in Group R.Patient has significant postoperative pain relief noted upto 7th hour in Group B and upto 8th hour in Group R.

Table 2: Duration of Postoperative Analgesia Comparison between group R and group B

Time in Hours	Group R	Group B	P value
5hours		3(16.66%)	
6hours	1(5.55%)	6(33.33%)	
7hours	5(27.77%)	9(50.0%)	
8hours	10(55.55%)		
10hours	2(11.11%)		
Mean±SD	7.83±0.98	6.33±0.76	<0.001

Above table shows duration of postoperative analgesia comparison between Group R and Group B. Above table shows that patient having pain relief maximum up to 8th hour in Group R and 7 hours in Group B. Maximum number of patient achieved pain relief at 8th hour in Group R and at 7th hour in Group B. The average duration of postoperative pain relief in Group R is 7.83±0.98 hour & Group B is 6.33±0.76 hour. Which is statistically significant difference between Group R and Group B in

total duration of postoperative analgesia.($p<0.001$). Above representative data shows there is statistically significant in postoperative total duration of analgesia at 5-hour, 6 hour and 8 hour.

Table 3: Total Number of Rescue Analgesia

Parameters	Group R (Mean±SD)	Group B (Mean±SD)	Pvalue
No. of Rescue Analgesia in 1st 24hrs	0.17±0.38	0.55±0.51	<0.05

Above table and diagram shows that there is significant difference in requirement of Total Number Of Rescue Analgesia In between Group R and Group B.Group R required comparative lesser number of rescue analgesia than Group B. None of the patients from either group had any complications like nausea/vomiting/sedation, Respiratory depression/ dyspnoea. Bradycardia/ tachycardia, Hypertension/ hypotension, Chest pain, Local anaesthetic toxicity. Hypersensitivity. Haematoma. Post block neuropathy. Convulsion /dizziness /cramps / hypoanesthesia, Anxiety, Rigors.

Conclusion

We conclude from our study that the Ropivacaine 0.25% when compared to Bupivacaine 0.25% in dose of 40 ml in 3 in 1 Femoral Nerve block after knee surgeries for postoperative pain relief –

1. Ropivacaine has prolonged duration of analgesia.
2. VAS score of Ropivacaine is less in comparison to Bupivacaine.
3. Ropivacaine has prolonged the duration of post operative pain relief in comparison with Bupivacaine.
4. Ropivacaine as well as Bupivacaine has stable vital parameters in our study.
5. Number of rescue analgesia requirement less in Ropivacaine group.

No incidence of complication and toxic reaction was observed from either group.

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