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COMPARATIVE STUDY OF DUAL SUBSARTORIAL BLOCK VERSUS EPIDURAL BLOCK FOR POST OPERATIVE ANALGESIA IN KNEE SURGERIES

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KEYWORDS :

INTRODUCTION

Knee surgeries are the most commonly performed orthopedic procedure that are associated with significant post operative pain despite systemic analgesic administration. Dual subsartorial block is a novel procedure specific motor sparing regional anaesthesia technique where local anesthetic is deposited under subsartorial muscle with two injections (dual) that combined two blocks: femoral triangle and adductor canal block respectively[1]. Epidural block is a central neuraxial block technique with multiple applications where local anaesthetics are deposited in the epidural space to achieve post operative analgesia [2]

Ropivacaine is a long-acting Amide local anaesthetic agent and first produced as a pure enantiomer. It produces effects similar to other local anaesthetics via reversible inhibition of sodium ion influx in nerve fibers[3].

Aim

Compare efficacy of dual subsartorial block with epidural block for post operative analgesia in patients undergoing knee surgeries.

Objective

- Primary Objective is to compare Onset of analgesia in each group and Duration of analgesia in each group with time of first rescue analgesia.
- Secondary objective is to compare the sparing of motor block by assessing Quadriceps strength and modified Bromage scale in both the groups. Any significant difference in hemodynamic changes are also noted .

Inclusion and Exclusion Criteria

Patients with ASA I& II grade of both male and female genders, undergoing knee surgeries under subarachnoid block with duration of surgery not less than 120 minutes were included in our study. Exclusion criteria consisted of patient refusal, patients with infection at site of needle puncture or history of bleeding diathesis and coagulopathy and patients allergic to local anesthetics.

METHODOLOGY

The study was conducted in pre operative area of OT complex of MGM Medical College, Kamothe, Navi Mumbai. Were selected Sample size of 52 patients in each group. The sample size required in each arm of the study was calculated according to the formula: $N = 2(z\alpha + z1\text{-}\beta)2\ \sigma 2 / \delta 2$. Where σ (Pooled SD) = 1.12, δ (Difference of Means) = 0.8, Type I error (α) = 5%, $Z\alpha$ = 1.96, Type II error (β) = 5%, Power ($1 - \beta$) = 95%, and $Z1\text{-}\beta$ = 1.65. So, based on the formula given above, using the mentioned values, the sample size required is: 2*(1.96 + 1.65)2*1.122/0.82 = 51.08. Thus, assuming 95% power and 95% confidence interval, the inclusion of 52 patients in each group (total number of 104 patients) was considered sufficient to observe a significant difference between both groups. After obtaining written, valid, informed consent the patients undergoing knee surgeries are allocated to Group A and Group B by random chit lifting method with 52 patients in each group.

On the day of surgery , each patient's overnight fasting is confirmed. On arrival of the patient in the operating room,all ASA standard monitors were attached. An intravenous line is secured using 20 G i.v cannula at the beginning of surgery .Epidural catheter was put under strict asepsis in Group B prior to Sub arachnoid block, who received epidural analgesia with 10 ml (0.2%)Ropivacaine at the end of the surgery or two segment regression of Spinal anaesthesia whichever is earlier. Test dose with only 1 ml Lignocaine 2% with adrenaline is administered after securing the catheter to ensure correct positioning of the tip of the catheter. Spinal Anaesthesia was administered with 3ml 0.5% Bupivacaine heavy. NRS score is assessed every hourly till 8 hours post operative period. Group A received dual subsartorial block under strict asepsis with Ropivacaine (0.2%)20 ml at the end of the surgery or at the time of two segment regression of spinal Anaesthesia, whichever is earlier. First dose of intravenous Rescue analgesia (given when NRS is >5)time is noted. Quadriceps strength and Modified Bromage score were assessed every hourly starting from zero hour which is considered at the time of administering Local anaesthetics in both the groups.

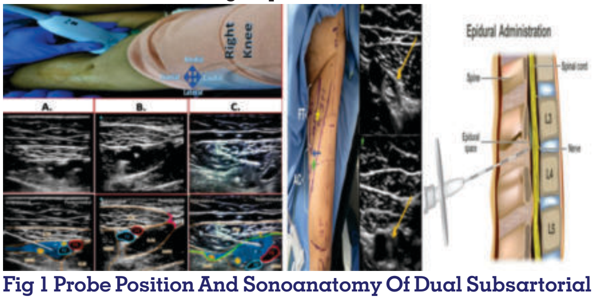


Fig 1 Probe Position And Sonoanatomy Of Dual Subsartorial Block

Modified Bromage Score

Score	Criteria
0	The patient is able to move hip, knee, and ankle
1	Patient is unable to move hip but able to move knee and ankle
2	Patient is unable to move hip and knee but able to move ankle
3	Patient is unable to move hip, knee, and ankle

RESULT

Postoperative pain scores were measured using a numerical rating scale(NRS) at regular intervals of one hour till eight hours post operatively. The quadriceps strengths were also measured periodically by a neurological exam, based on a 6-point (0-5) scale from the Medical Research Council (MRC) (0 = no contraction, 1 = flickering or signs of contraction, 2 = active movement without gravity, 3 = active movement against gravity, 4 = active movement against gravity and resistance, 5 = normal power). The data were entered using Microsoft Excel version 2010 and analyzed using Statistical Packages in Social Sciences Software version 20 (SPSS).Data were expressed as mean ± standard deviation using a chi-square test.

Table 1 below indicates between group comparison of intraoperative parameters.

The duration of analgesia (hour) was significantly longer in group A as compared to the group B (p<.001),Table 1 and Graph 2.

The Time to achieve Bromage 3 i.e. complete motor block was significantly less in group B as compared to the group A (p<.004),Table 1.

Quadriceps strength was better restored in group A than in group B(p<.002), Table 1 and Graph 3.

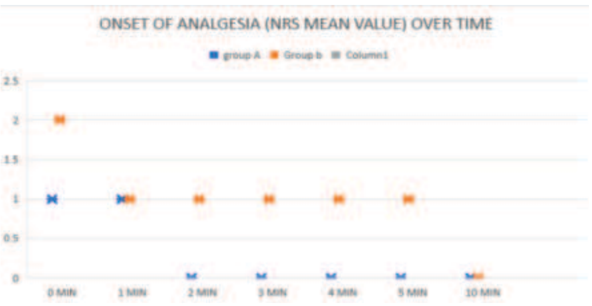
Duration of analgesia was better in Group A , Graph 2.

However, there were no significant hemodynamic changes between th

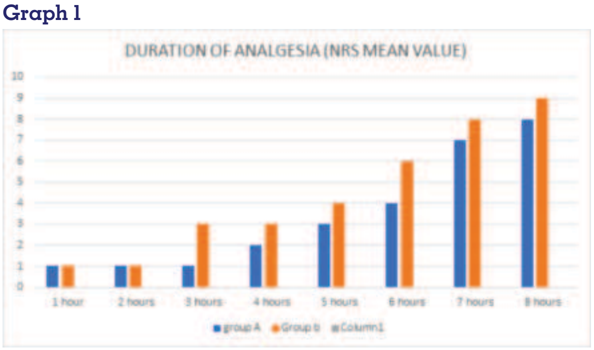
Table 1: Comparison of Intraoperative Observations

Group		N	Mean	SD	t-stat	p-value
I. Duration of Analgesia (hour)	Group A	52	6.155	0.898	-11.90	<.001**
	Group B	52	4.833	0.791		
ii. Quadriceps Strength (First hour)	Group A	52	3	0.012	-9.75	<.002**
	Group B	52	0	0.000		
iii. Time to achieve Bromage 3 in (hour)	Group A	52	1.233	0.898	-11.90	<.004**
	Group B	52	5.833	0.791		

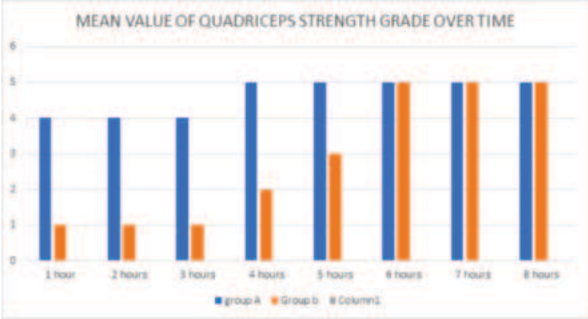
**: Significant at 5% level of significance, NS: Not significant



Graph 1



Graph 2



Graph 3

DISCUSSION

The knee joint is complexly innervated by the main branches of the lumbar and sacral plexus. These include the femoral nerve (anterior knee), obturator nerve (posteromedial knee), and sciatic nerve (posterior knee)[4] . The blockade of all three nerves provides complete analgesia in their respective territories. However, it is associated with unwanted motor blockade of quadriceps (femoral nerve), adductors (obturator nerve), and hamstring muscles (sciatic nerve). This causes the risk of falls, delayed mobility, and prolonged hospital stay . For these reasons, such blocks are not recommended in enhanced recovery after surgery (ERAS) protocol for knee surgery[5].

The novel "DSB" combines two sub sartorial blocks, the distal femoral triangle block and the adductor canal block[6]. This combination is given to block most of the innervations of the pain generating structures involved in TKA surgery. Various literatures have made the demarcation between the femoral triangle and adductor canal clear[7] . It is essential to understand the extent and content of both these prominent landmarks of the thigh. The femoral triangle (FT), also called Scarpa's triangle, is a subfascial space below the inguinal ligament that lies in the upper third of the thigh [8], bounded by the inguinal ligament, the medial border of the adductor longus muscle (ALM), and the medial border of the sartorius muscle (STM) laterally, the floor is formed by the pectineus and ALM medially and iliopsoas muscle laterally. Saphenous Nerve (SN) lies anterolateral to the femoral artery (FA) between the STM and vastus medialis muscle (VMM) . Nerve to vastus medialis (NVM) lies lateral to the SN in the groove between STM and VMM. Lateral femoral cutaneous nerve (LFCN) crosses the lateral angle of the FT[8,9,10]. Femoral nerve (FN) enters the FT by passing beneath the inguinal ligament, just lateral to the FA. In the thigh, it lies in a groove between the iliacus and psoas major muscles, outside the femoral sheath, and lateral to the FA. After a short course in the thigh, the FN is divided into anterior and posterior divisions, separated by the lateral femoral circumflex artery. Nerve to pectineus arises from the FN just above the inguinal ligament. It passes behind the femoral sheath to reach the anterior surface of the pectineus muscle . The femoral sheath (enclosing upper 4 cm of the femoral vessels) contains a femoral branch of the genitofemoral nerve, FA and its branches, femoral vein and its tributaries, and deep inguinal lymph nodes. The Adductor Canal (AC), also known as Hunter's canal or the subsartorial canal, is a musculoaponeurotic tunnel in the middle third of the thigh. It extends from the apex of the FT above to the tendinous opening in the adductor magnus muscle (AMM), called adductor hiatus, below. The subsartorial plexus lies in this region sandwiched between STM and VAM. (Figure 1). The desired results of the DSB depend on the understanding of the anatomy of two prominent landmarks in the thigh (FT and AC) separated by the FT apex to locate target-specific innervations [26-28]. The STM can be seen as a common muscular landmark under ultrasound from the distal FT to the distal AC regions for both femoral triangle and adductor canal blocks. Therefore, the area below the STM in these regions can generally be referred to as the subsartorial area. The DSB is a hybrid form of subsartorial block, in which the combination of two subsartorial blocks (distal femoral triangle and adductor canal block) is used to cover all procedure-specific innervations of pain generators involved in TKA surgery[11,12,13,14]. In this block, the local anesthetic drug is deposited under the sartorius muscle at two different places, so it is termed as a "Dual Subsartorial Block." The DSB is given immediately after the surgery with two different injections at two different locations.

The DSB requires a larger volume (20-30 mL) of LA solution to adequately cover all the innervation .The high-frequency linear ultrasound probe is placed over the mid-thigh. The anterolateral VMM, posteromedial ALM, and medial STM are identified. The DSB can be given by following 3 simple steps, 1. Identifying the apex of the femoral triangle 2. First injection (distal femoral triangle block) 3. Second injection (adductor canal block) The apex of the femoral triangle is identified where the medial border of STM overlies the medial border of ALM, forming a sign of "3" or "kissing Sign," as shown in Figure 1. For distal femoral triangle block , after identifying the apex of the FT, an ultrasound probe is moved slightly (1-2 cm) proximally. A 100 mm Stimuplex needle is inserted in-plane from the lateral aspect of the thigh. Second injection (adductor canal block)is given . The high-frequency linear ultrasound probe is placed just (1-2 cm) distal to the FT apex, i.e., below the sign of "3", A 10-20 cc of LA mixture is deposited next to the FA under the VAM, typically seeing a disappearing spread of drug and compression of the vessel. The first injection (distal femoral triangle block) will target SN and NVM directly. Next, the distal spread of the drug under STM but above the VAM targets the subsartorial plexus, which is sandwiched between VAM and STM in the adductor canal region (Figure 4C). In the second injection (adductor canal block), no nerves are targeted. Simply depositing the drug perivascularly (around FA) under the VAM is sufficient to obtain the desired outcome. A drug injected into the adductor canal below VAM will travel along the femoral vessels and enter the adductor hiatus to reach the posterior aspect of the knee joint. It blocks the popliteal plexus formed by the articular branches from the posterior division of the obturator nerve, tibial, common peroneal, and sciatic nerve.

Epidural analgesia may be useful for postoperative pain relief following major lower limb joint replacements. However, the benefits may be limited to the early (four to six hours) postoperative period[15,16]. The magnitude of pain relief must be weighed against the frequency of adverse events.The Epidural catheter is placed under strict asepsis in between fourth and fifth Lumber vertebral space by LOR technique and confirmed by witnessing positive meniscus sign, secured properly. The required LA dose is administered at the end of surgery.

Postoperative pain management contributes greatly to achieve enhanced recovery after surgery (ERAS) goals. Single shot epidural analgesia is limited to brief pain relief (<6 hours)[15]. Analysis of functional outcomes included Quadriceps strength ,distance walked on postoperative day one, measured in feet. Passive range of motion (ROM) was measured using a goniometer. Passive knee flexion and extension data were collected on postoperative day one and at discharge(Modified Bromage score)[17]. Length of stay was compared between the two groups using the Wilcoxon rank-sum test. Pain scores, walking distance, and Quadriceps strength at postoperative day one and on discharge as well were compared between the groups using the independent samples.

CONCLUSIONS

Perioperative pain management for patients undergoing TKR is complex and challenging. A holistic approach is required to manage such multifactorial postoperative pain taking into account the patient's age, comorbid factors, complex innervations of pain generators, the demand for the most appropriate analgesic option, enhanced recovery, and early mobilization. Such an approach helped us keep our patients' overall satisfaction score of 4/5 (very good) at discharge with the existing analgesia protocol.

Despite the strength of our study, including randomization and double-blind design to avoid biases and assessment of all study parameters till the discharge of the patient, our study has several limitations. One of the limitations is its monocentric design and another is the small sample size we can not generalize our observations to all TKR surgeries with a limited number of patients included in this study.

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