



COMPARISON OF ULTRASOUND GUIDED ADDUCTOR CANAL BLOCK AND INTRA-ARTICULAR LOCAL ANESTHETIC INFILTRATION IN TOTAL KNEE REPLACEMENT SURGERIES - A PROSPECTIVE RANDOMISED STUDY

Anesthesiology

Dr. Subhashree Jayaraman	MD, Assistant Professor, Department of Anaesthesiology, BIRRD(T) Hospital, TTD, Tirupati.
Dr. Vineeth Reddy. G*	MD, Assistant Professor, Department of Anaesthesiology, BIRRD(T) Hospital, TTD, Tirupati. *Corresponding Author
Dr. K. Pradeep Kumar	MD, HOD, Department of Anaesthesiology, BIRRD(T) Hospital, TTD, Tirupati.
Dr. Ashalatha Pasupuleti	MD, Assistant Professor, Department of Anaesthesiology, BIRRD(T) Hospital, TTD, Tirupati.

ABSTRACT

Osteoarthritis knees is a common condition in elderly patients for which total knee arthroplasty is the gold standard treatment. Effective postoperative analgesia will help in rapid recovery, short hospital stay and reduce the development of chronic pain. We conducted this randomised, prospective study to compare the efficacy of adductor canal block and local anesthetic infiltration in patients undergoing total knee replacement surgeries. Hundred patients were included in the study, fifty in each group. We observed VAS score at 3, 6, 12, 24 hours and the time to require rescue analgesia. We observed that VAS score at 3 hours was less in adductor canal group with prolonged time for rescue analgesia than the local infiltration group.

KEYWORDS

adductor, local infiltration, intra articular, knee replacement

Osteoarthritis of knee is a common condition seen in the elderly population. Total Knee Arthroplasty (TKA) is the gold standard treatment for management of severe osteoarthritis Knee. TKA is associated with extensive tissue damage and excruciating pain in the postoperative period. Multidisciplinary approach for post-operative pain management without affecting the patient's ability to mobilise is required for rapid functional recovery, reduction in the hospital stay. Poor management of pain in the intra-operative and acute post-operative period can result in chronic pain(2). So post-operative pain management is very important in patients undergoing TKA to reduce the incidence of chronic pain.

Commonly used methods to reduce postoperative pain in TKR are intravenous opioids, epidural analgesia, regional nerve blocks and intra articular local anesthetic infiltration. The wide spread usage of regional anaesthesia has reduced the post-operative opioid consumption and its adverse effects like post-operative nausea, vomiting, respiratory depression, opioid addiction and dependence. Regional nerve blocks help in providing effective post-operative pain management, thereby allowing early recovery and reduced hospital stay. Epidural anaesthesia can cause excessive motor block, inadvertent Intrathecal administration, cauda equine syndrome and CNS infection due to indwelling catheter, limited its usage. Femoral nerve block and adductor canal block are commonly used regional nerve blocks. Femoral nerve block can cause significant motor blockade of Quadriceps which can inhibit rehabilitation(1). Adductor canal block at the mid part of the thigh will provide sensory block for pain equivalent to femoral nerve block without causing motor nerve block to the Quadriceps mechanism, thereby allowing early mobilisation.

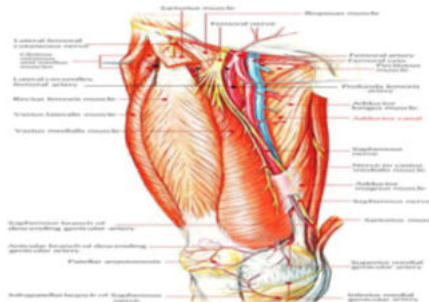
Last will be the local infiltration analgesia for TKA. The simplicity of the technique, limited time taken to perform and the avoidance of motor blockade, thereby enabling the early rehabilitation has led to increased adoption of local infiltration. However there is lack of evidence if local infiltration technique alone can provide satisfactory postoperative analgesia. Injection of large volumes of local anaesthetic agents with adjuvant drugs around the knee joint increases the risk of local anaesthetic associated systemic toxicity and studies need to be performed to examine these concerns.

Adductor Canal Block

The femoral nerve passes through the femoral canal and lies beneath the Sartorius muscle. It enters an aponeurotic intermuscular tunnel in the middle third of the medial side of the thigh called Adductor canal or Hunter's canal. Approximately two thirds down the thigh, femoral

vessels pass through the adductor hiatus. They change course and become deeper, indicating the end of the canal and the point at which the nerves that supply quadriceps exit. Few of the sensory articular nerve branches exit proximal to the Adductor canal therefore, an Adductor canal block may provide inferior anaesthesia for knee surgery compared to a classical femoral nerve block. The Adductor canal block is considered a purely sensory block, with the motor branches to the quadriceps exiting more proximally, however proximal spread of large volumes of local anaesthetic may cause some motor blockade of vastus medialis and difficulty in ambulation.

The adductor canal is triangular in cross section. Its boundaries are as follows. Anterolateral wall is formed by vastus medialis, Posterior wall (floor) is formed by adductor longus above and adductor magnus below and medial wall (roof) is formed by a fibrous membrane stretching across the anterolateral and posterior borders. The roof is overlapped by the Sartorius muscle. The apex of the adductor canal is formed by the adductor hiatus.



The sub sartorial plexus of nerves is located on the roofing underneath the Sartorius. The plexus is composed by branches from the medial cutaneous nerve of the thigh, the saphenous nerve, the anterior section of the obturator nerve. It supplies the overlying fascia lata and the skin.

Contents of Adductor Canal

The adductor canal serves as a passage way for structures moving between the anterior thigh and posterior leg, its content includes Femoral artery, femoral vein, Nerve to the vastus medialis, Saphenous nerve (the largest cutaneous branch of the femoral nerve), Anterior and posterior sections of the obturator nerve (occasional), Descending genicular artery (a branch of the femoral artery), as the femoral artery and vein exit the canal, they become the popliteal artery and vein respectively.

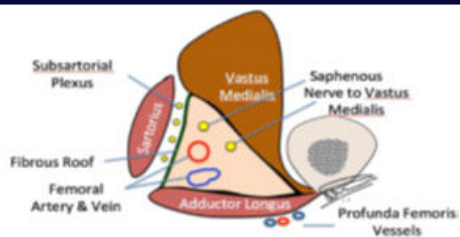


Figure 2: Contents of Adductor Canal

Knee joint is supplied by femoral nerve through its branches to vastus medialis, sciatic nerve through genicular branches of tibial & common peroneal nerve, obturator nerve through its posterior division and infrapatellar branch of saphenous nerve.

Ultrasound guided adductor canal block can be given through in plane and out of plane approach. we have used in plane approach to give adductor canal block.

In-plane Approach

The patient is placed in supine position with the knee slightly flexed and externally rotated. The ultrasound machine, operator, insertion site and ultrasound machine are positioned in such a way that they lie in series thus improving ergonomics and chance of success (6-12) MHz frequency linear probe is placed axially at the level of the central mid-thigh, visualising the femur. The probe is slid medially until the femoral artery becomes visible with the boat shaped Sartorius muscle above it. The depth is adjusted so that the femoral artery and Adductor canal lie in the centre of the screen. The femoral artery is traced to the point at which the artery divides posteriorly ultimately becoming the popliteal artery. The optimal position for insertion is immediately proximal to the adductor hiatus. The nerves are visualized anterolateral to the artery. The needle is inserted from lateral to medial using an in plane technique. This is achieved via a steep angle traversing Sartorius, or more horizontally, by piercing vastus medialis and travelling perpendicular to the ultrasound beam.

The needle is inserted parallel to the ultrasound beam and the shaft of the needle is visualized as an echogenic white line. Alignment of the ultrasound beam and the needle in this approach is important. The target structure is usually placed (16) to one side in the ultrasound field, and the needle is advanced from the other side towards the target, usually at an angle of 45° or less. Once the needle enters the Adductor canal, the needle tip is made to lie immediately lateral to the femoral artery. An aspiration test is performed and then a test dose of 0.5% Bupivacaine is injected, ensuring spread around the nerve. If the nerve is not visible, the needle tip is positioned superficial to the artery and the local anaesthetic agent spread around the artery is ensured. Once the correct position has been confirmed, the total volume of 20ml of 0.5% Bupivacaine is deposited, aspirating frequently to rule out intravascular injection.

The adductor canal also called as sub-sartorial block, is a largely motor sparing block, anaesthetizing the femoral nerve after most of its motor branches to quadriceps have already exited, providing analgesia postoperatively for surgeries to the anterior part of the knee like patellar surgery, knee arthroscopy, MCL and ACL reconstruction.

We designed this prospective randomised study to compare the efficacy of local infiltration analgesia and ultrasound guided adductor canal block in patients undergoing knee replacement surgeries.

Primary Objective

To assess postoperative pain using visual analogue scale pain score at 3,6,12 and 24 hours.

Secondary Objectives

1. To evaluate the time to first rescue analgesic administration.
2. To assess the complications

After obtaining institutional ethics committee approval, 100 patients were included in this study. Written informed consent was taken from all the patients. They were randomly allocated to two groups based on computer randomisation table. Group A received adductor canal block with 20ml 0.25% bupivacaine with 10µg dexmedetomidine and group

L received local infiltration analgesia with 20ml 0.5% bupivacaine with 10µg dexmedetomidine, 300µg adrenaline to a volume of 50ml

Group A- USG guided adductor canal block

Group L - Local infiltration analgesia

Inclusion Criteria

Hundred patients (50 in each group) aged between 50 to 75 years, belonging to ASA - I, II posted for Elective knee replacement surgeries were included in the study.

Exclusion Criteria

Patients who were not willing, history of allergy to local anaesthetics or opioids, revision arthroplasty, bleeding tendency due to anticoagulant therapy, preoperative DVT, chronic pain requiring opioid medication were excluded from the study.

After shifting the patient to operation theatre, Intravenous line was secured using 18G IV cannula and Ringer Lactate was started at the rate of 2ml/kg/hr. NIBP, ECG, SPO₂ monitors were connected and baseline values were recorded. All patients in the study received spinal anaesthesia with 3ml of hyperbaric bupivacaine (0.5%) using 25G Quincke's needle. After assessing the level of block, surgery was done using a standard surgical method with thigh tourniquet. Patients were given either local infiltration analgesia or USG guided adductor canal block based on groups allocated by random numbers.

Group A (USG Guided Adductor Canal Block)

Immediately after the completion of surgery, under aseptic precautions, a 6-12 MHz USG probe was placed transversely on the antero-medial aspect of mid-thigh to obtain a short axis view of the adductor canal. Adductor canal block was given using in plane technique with 20ml of 0.25% bupivacaine until its spread around the artery is confirmed with ultrasound visualization.

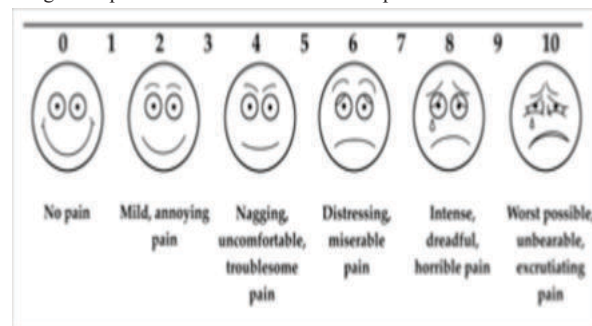
Group L (Local Infiltration Analgesia)

Intra-operatively, the local infiltration analgesia group received local infiltration of 20 ml of 0.5% bupivacaine, 10µg dexmedetomidine and adrenaline 200mcg in a total volume of 50 ml by the surgeon.

We assessed the postoperative pain using visual analogue scale pain score and the time to first rescue analgesic administration was noted. Postoperative pain was assessed at 3, 6, 12 and 24 hours from the time of administration of the block using visual analogue scale pain score.

Visual Analogue Score

The pain VAS is a continuous scale comprised of horizontal (HVAS) or vertical (VVAS) line or a usually 10 centimetres (100 mm) in length, anchored by 2 verbal descriptors, one for each symptom extreme. For pain intensity, the scale is most commonly anchored by —worst imaginable pain with the score of 100 and no pain with the score of 0.



Time for the requirement of rescue analgesia was noted in both the groups. Rescue analgesia was given when VAS score was less than or equal to 4, with intravenous paracetamol 1g and intravenous tramadol 50mg.

RESULTS

The collected data were analysed with IBM.SPSS statistics software 23.0 Version.

Table-1: Age Distribution Of The Study Population (n=100)

parameter	Group A	Group L	
50-60yrs	13	15	
60-70yrs	27	23	P value-0.779
70-80yrs	10	12	

Table 2: Gender Distribution Of The Study Population

parameter	Group A	Group L	
Male	27	24	P value -0.767
Female	23	26	

The demographic parameters were comparable between the groups (table-1,2).

Table 3: VAS Score In The Study Population

Parameter	Group A (mean±SD)	Group L (mean±SD)	P value
VAS at 3hrs	1.0 ± 3.3	3.1 ± 4.6	0.002 #
VAS at 6hrs	2.33 ± 1.75	3.0 ± 1.85	0.194
VAS at 9hrs	3.1 ± 1.83	3.5 ± 1.93	0.236
VAS at 12hrs	5.37 ± 1.34	5.97 ± 2.49	0.437

statistically significant

VAS score at 3hrs was less in adductor canal group than the local infiltration group, with p value less than 0.05, which is statistically significant. VAS score at 6, 9, 12hrs were comparable between two groups.

Table 4: Time For Rescue Analgesia

Parameter	Group A (mean±SD)	Group L (mean±SD)	P value
Time (Hrs)	17.63 ± 6.55	12.76 ± 4.13	0.005

Patients who received adductor canal block required rescue analgesia approximately 17hours after the block (later than the local infiltration group), which is statistically significant.

DISCUSSION

Postoperative pain is often overlooked and up to 70% of patients report moderate to severe pain following surgery. Pain control is of prime importance in improving the quality of patient care, reduced hospital stay and reduces the incidence of chronic pain. Regional nerve block techniques gained popularity since a decade because it offers superior postoperative pain relief without systemic effects, facilitates early ambulation and discharge. Ultrasound guided blocks helps in accurate placement of needle thereby improving the success rate and also reduces the complications due to inadvertent injury to vital structures in landmark based techniques.

Acute postoperative pain following Total Knee Arthroplasty is maximum during the first 24 hours. Various modalities have been adopted to reduce this post-operative pain with NSAIDs, parenteral opioids, central neuraxial analgesia, femoral nerve block, adductor canal block and local anesthetic infiltration with varying results. Among these techniques, , adductor canal block and local anesthetic infiltration found to be effective and easy to perform with less complications. There are few studies [3-5] comparing ultrasound guided adductor canal block with infiltration for postoperative pain relief and functional outcome, the results of those studies have contrasting inferences.

We conducted this randomized prospective study to compare the efficacy of USG guided adductor canal block with local infiltration analgesia in providing postoperative pain relief in patients undergoing total knee arthroplasty under spinal anaesthesia. We compared the VAS pain scores and time to first rescue analgesia between USG guided adductor block and local infiltration analgesia over a period of 24 hours. Mean VAS score at 3hrs was less in adductor canal block (1.0 ± 3.3) than the local infiltration group (3.1 ± 4.6), which is statistically significant. Mean VAS score at 6, 9, 12 hrs were comparable between both the groups. Rescue analgesia was given on patients demand as per the patient's requirement when VAS scores were greater than or equal to 4. The mean time for rescue analgesia in group 1 (USG guided ACB) was 17.63 hours and in group 2 (local infiltration analgesia) was 12.76 hours with p value of 0.005 which was highly significant.

Q.J. Tong et al[3] and W. Kampitak et al[4] concluded that USG guided adductor canal block provided better post-operative analgesia in terms of reduced morphine consumption in the first 24 hours and 48 hours than local infiltration analgesia without having negative impact on the functional outcome in TKA patients. Whereas MJ Grosso et al [5] study which concluded that mean VAS pain score & opioid consumption on POD 1 and POD 3 was significantly higher in the ACB group than the PAI alone and PAI + ACB group. In our study, we also

observed that USG guided adductor canal block provided superior analgesia at 24 hours and the time to first rescue analgesia was prolonged than local infiltration analgesia

CONCLUSION

We concluded that ultrasound guided adductor canal block provides superior analgesia with less requirement for rescue analgesia at 24hours than the local anesthetic infiltration alone in total knee arthroplasty surgeries.

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