**ORIGINAL RESEARCH**

# Scope of dexmedetomidine as an adjuvant to 0.25% bupivacaine in femoral nerve block for postoperative analgesia after unilateral total knee replacement

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**ABSTRACT**

**Background and objectives:** To evaluate the efficacy of Dexmedetomidine as an adjuvant to 0.25% Bupivacaine in the femoral nerve block for postoperative analgesia following unilateral total knee replacement under spinal anaesthesia. **Methodology:** 60 patients who were posted for TKR taken up for our study after obtaining written informed consent. Femoral nerve block was administered under ultrasound guidance once the sensory level recedes to T12 dermatome. Here, patients were randomly allocated into two groups (A&B) using a computer-generated randomization chart. Patients in group A received 20ml of 0.25%Bupivacaine with Dexmedetomidine (0.5 mcg/kg) made up to 1ml (total 21ml). Patients in group B received 20ml of 0.25% Bupivacaine with 1ml normal saline (total 21ml). Pain was assessed using VAS, Motor power of lower limb was recorded with MBS and vitals are closely monitored. All the observations are tabulated and statistically analyzed. **Results:** In group A the mean duration of analgesia is 16.73(±1.14) and in group B the mean duration of analgesia is 11.3(±1.15), P value is statistically significant. **Conclusion:** Dexmedetomidine as an adjuvant to Bupivacaine prolongs theduration of analgesia in femoral nerve block after unilateral total kneereplacement.

**Keywords:** Total knee replacement, Femoral nerve block, Bupivacaine, Dexmedetomidine.



## INTRODUCTION

Total knee replacement is successful procedure for treating patients with osteoarthritis to relieve joint pain, increase mobility, and improve quality of life.Patients undergoing total knee replacement surgery experience considerable postoperative pain. [1,2]It not only impairs early mobilization and rehabilitation but also prolongs the hospitalization.

Pain is typically the main component of patients with knee osteoarthritis. Pain is subjective and it involves peripheral and central neural mechanisms that are modulated by Neuro chemical, environmental, psychological, and genetic factors. Pain management after total knee replacement is still challenging, but is important due to good pain management can improve the outcome of patients.

The postoperative pain is caused by inflammation resulted from direct nerve injury or the tissue injury. Patients can perceive the pain through afferent pain pathway, this is the target of a variety of drugs. Direct local anaesthetics or the drugs that reduce the response of local hormones to injury (nonsteroidal anti-inflammatory drugs, such as ibuprofen or aspirin) can be utilized to block the activity of pain receptors, thereby reducing the activity of pain receptors.

Opioid is frequently used for postoperative pain management. However, it may be associated with many adverse effects, including headache, nausea, vomiting, respiratory depression, retention of urine, and constipation. Specific medical diseases related to the inadequate pain control involved myocardial infarction, coronary ischemia, venous thrombosis, and pneumonia. Effective postoperative analgesia can reduce opioid consumption and promote rehabilitation. Several methods have been applied to reduce postoperative pain after TKR including the peripheral nerve block and the local infiltration anesthesia, intravenous analgesics as well as the epidural anesthesia.Femoral nerve block (FNB) was reported to reduce postoperative pain and has

increased in popularity because of its opioid sparing effects, and consistency with anticoagulatory therapy. FNBs can be performed as a single shot or as a continuous block using a catheter and an infusion. Continuous nerve blocks have the advantage of permitting the delivery of analgesia for a longer postoperative duration than single-shot nerve blocks. Nerve blocks have also been shown to result in a reduced need for parenteral or oral analgesia to control pain and in reported pain levels.

Bupivacaine is an amide local anesthetic that has shown high efficacy in terms of onset and duration of Femoral nerve block . To improve the quality of peripheral nerve blocks, many adjuvants to local anesthetic's are added. One such agent is Dexmedetomidine, and it is an alpha 2 agonist [5]. Dexmedetomidine ($\alpha_2$ adrenoceptor agonist) is being used for intravenous (IV) sedation and analgesia for intubated and mechanically ventilated patients in Intensive Care Units. Its use in peripheral nerve blocks has recently beendescribed. It has been reported to have a rapid onset time, to prolong the duration of local anesthetics, and is also reportedly safe and effective in peripheral nerve blocks.

## MATERIALS AND METHODS

The present study was a single-center, Hospital based Prospective randomized double-blind Study conducted on patients scheduled for unilateral total replacement. The study was conducted after obtaining approval from the institutional ethics committee and informed written consent.60 patients were randomly allocated into two groups of 30 each.

## INCLUSION CRITERIA

Patients scheduled for unilateral total knee replacement.

## EXCLUSION CRITERIA

- Patient refusal
- Infection at the local site
- Allergy to local anesthetics
- Bleeding disorders

## METHOD OF STUDY

60 Patients posted for total knee replacement surgery, during their pre-anaesthetic checkup (PAC), were explained about all the modalities of anaesthesia and analgesia feasible to them and those patients who are willing to participate in the study were evaluated for the inclusion and exclusion criteria. Patients satisfying the inclusion criteria were enrolled for the study after taking written informed consent.After surgery patients were shifted to post anaesthesia care unit (PACU) and were monitored until the resolution of subarachnoid blockade to T12 dermatome, and FNB administered under ultrasound guidance. Here, patients are randomly allocated into two groups A & B using a computer-generated randomization chart.Patients in group A received 20ml of 0.25%Bupivacaine with Dexmedetomidine (0.5 mcg/kg) made up to 1ml (total 21ml).Patients in group B received 20ml of 0.25% Bupivacaine with 1ml normal saline (total 21ml). Pain was assessed using visual analog scale(VAS), Motor power of lower limb was recorded with modified bromage scale (MBS) and vitals are closely monitored. All the observations are tabulated and statistically analyzed.

## STATISTICAL ANALYSIS

All the quantitative data was tested using student t-test and qualitative data by chi square test.

$P<0.05$ were statistically significant.

When variables are continuous variables for equivalence design, the formula is

$$n > 2\left[\frac{(z_{1-\alpha/2} + z_{1-\beta})\sigma}{\delta}\right]^2.$$

Where n= size per group

$Z_{1-\alpha/2}$& $Z_{1-\beta}$ =standard normal deviation σ = clinically acceptable margin δ = standard deviation of both comparison groups n = 2265.99/81 = 27.97 approx. 30 for each group

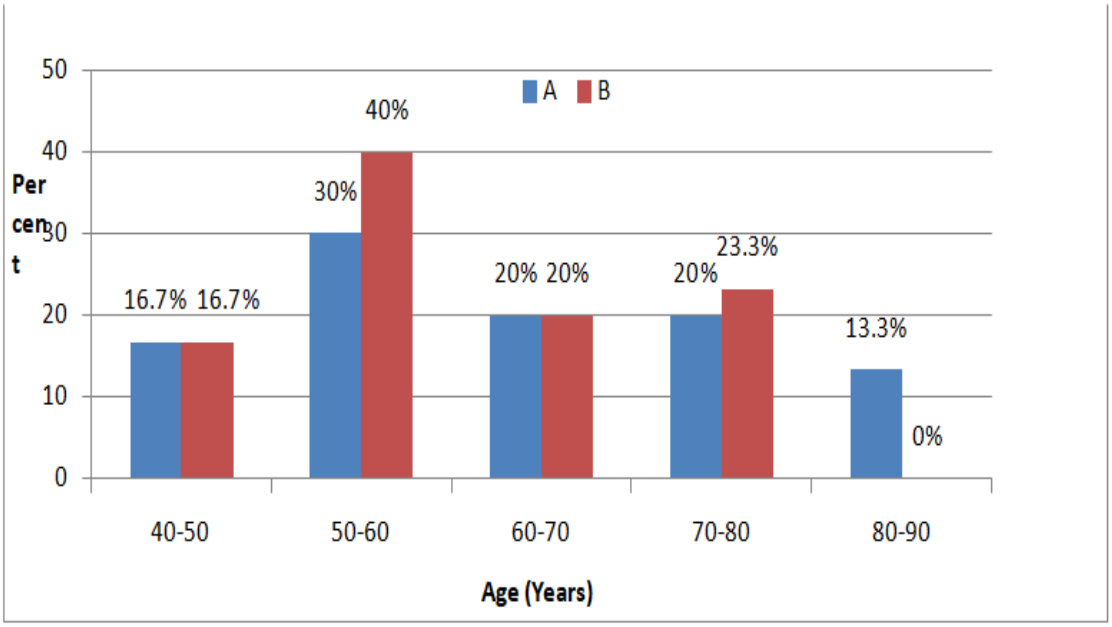
## RESULTS

During the present study a total of 60 subjects were taken into study Group A and B were comparable with regard to their age, weight, sex.

**Table1: Association between Study Group and Age (N=60)**

| Age (Years) | GROUP A | | GROUP B | |
|---|---|---|---|---|
| | (n=30) | n (%) | (n=30) | n (%) |
| 40-50 | 5 | 16.7% | 5 | 16.7% |
| 50-60 | 9 | 30.0% | 12 | 40.0% |
| 60-70 | 6 | 20.0% | 6 | 20.0% |
| 70-80 | 6 | 20.0% | 7 | 23.3% |
| 80-90 | 4 | 13.3% | 0 | 00.0% |
| **Mean** | **2.83** | | **2.50** | |
| **SD** | **1.31** | | **1.04** | |
| **Chi-Square Test, P Value=.342, not significant** | | | | |

**Graph 1: Bar diagram for comparison of Groups A & B with Age**

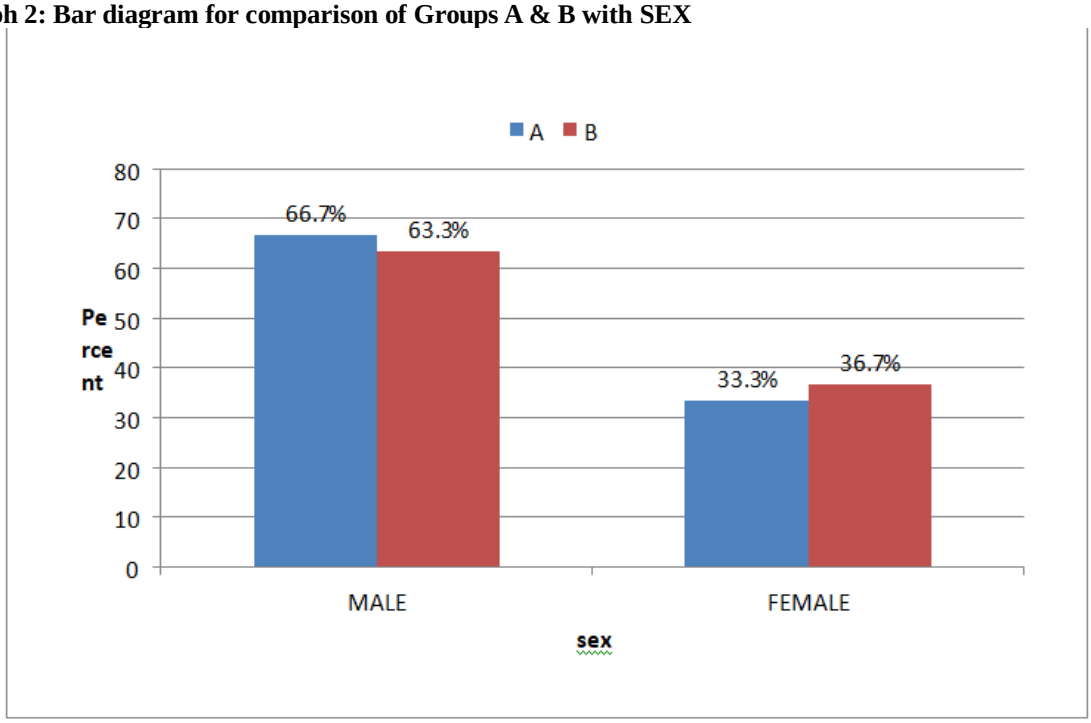



The patients are now divided into two groups based on their sex in the following table.

**Table 2: Association between Study Group and Sex (N=60)**

| Sex | GROUP A | | GROUP B | |
|---|---|---|---|---|
| | (n=30) | n (%) | (n=30) | n (%) |
| 1 | 20 | 66.7% | 19 | 63.3% |
| 2 | 10 | 33.3% | 11 | 36.7% |
| Chi-Square Test, P Value=0.5, not significant | | | | |

**Graph 2: Bar diagram for comparison of Groups A & B with SEX**



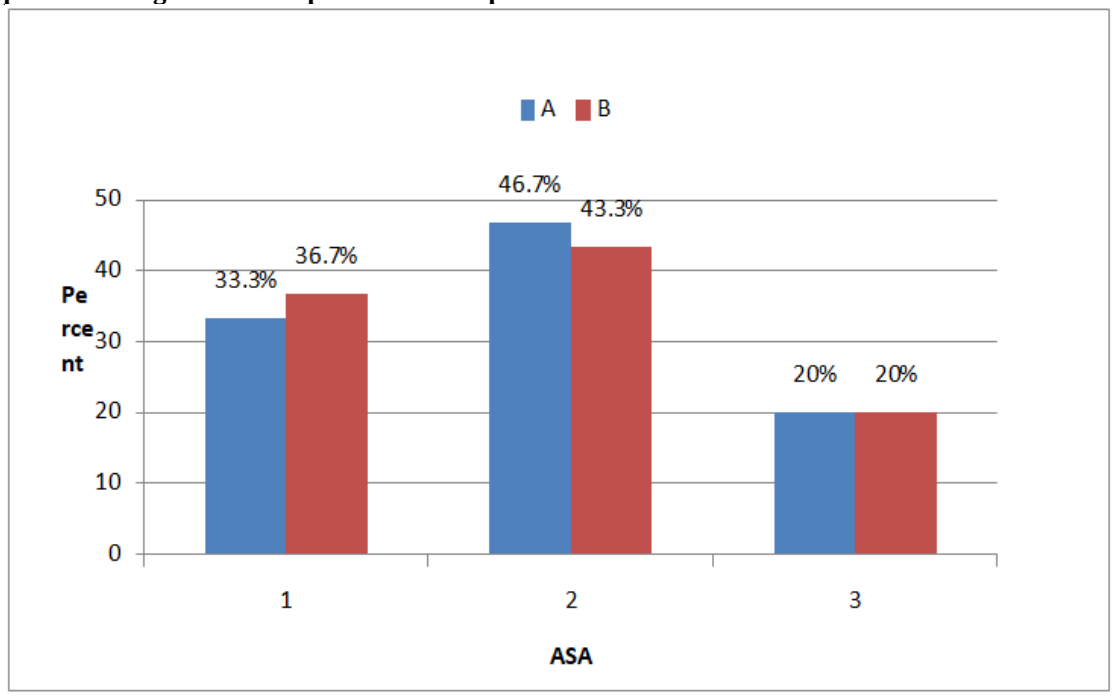

The patients are compared for the association between study groups and ASA in the following table

**Table 3: Association between Study Group and ASA (N=60)**

| ASA | GROUPA | | GROUPB | |
|---|---|---|---|---|
| | A (n=30) | n (%) | B (n=30) | n (%) |
| 1 | 10 | 33.3% | 11 | 36.7% |

| | | | | |
|---|---|---|---|---|
| 2 | 14 | 46.7% | 13 | 43.3% |
| 3 | 6 | 20.0% | 6 | 20.0% |
| **Chi-Square Test, P Value=0.959, not significant** | | | | |

**Graph 3: Bar diagram for comparison of Groups A & B with ASA**

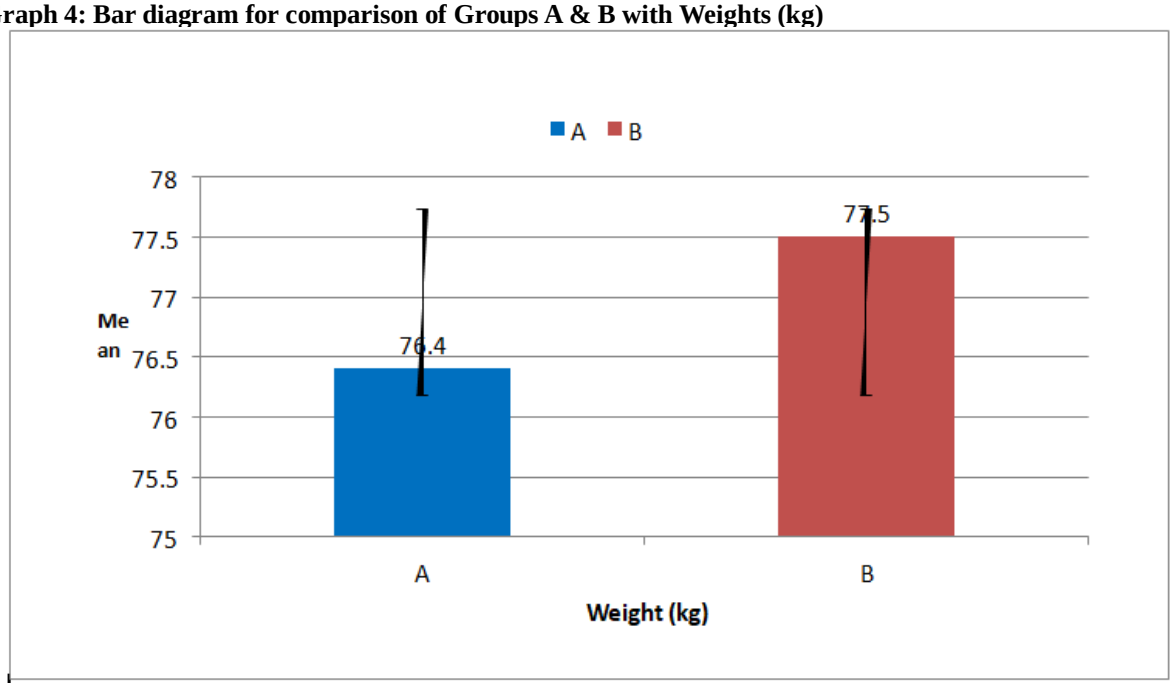



The patients are compared for the association between study group and weight in the following table

**Table4: Association between Study Group and Weight (N=60)**

| Weight(kg) | GROUP A (n=30) | | GROUP B (n=30) | |
|---|---|---|---|---|
| | Mean | SD(±) | Mean | SD(±) |
| | 76.40 | 6.015 | 77.50 | 8.784 |
| **Unpaired t Test, P Value=0.574, not significant** | | | | |

**Graph 4: Bar diagram for comparison of Groups A & B with Weights (kg)**

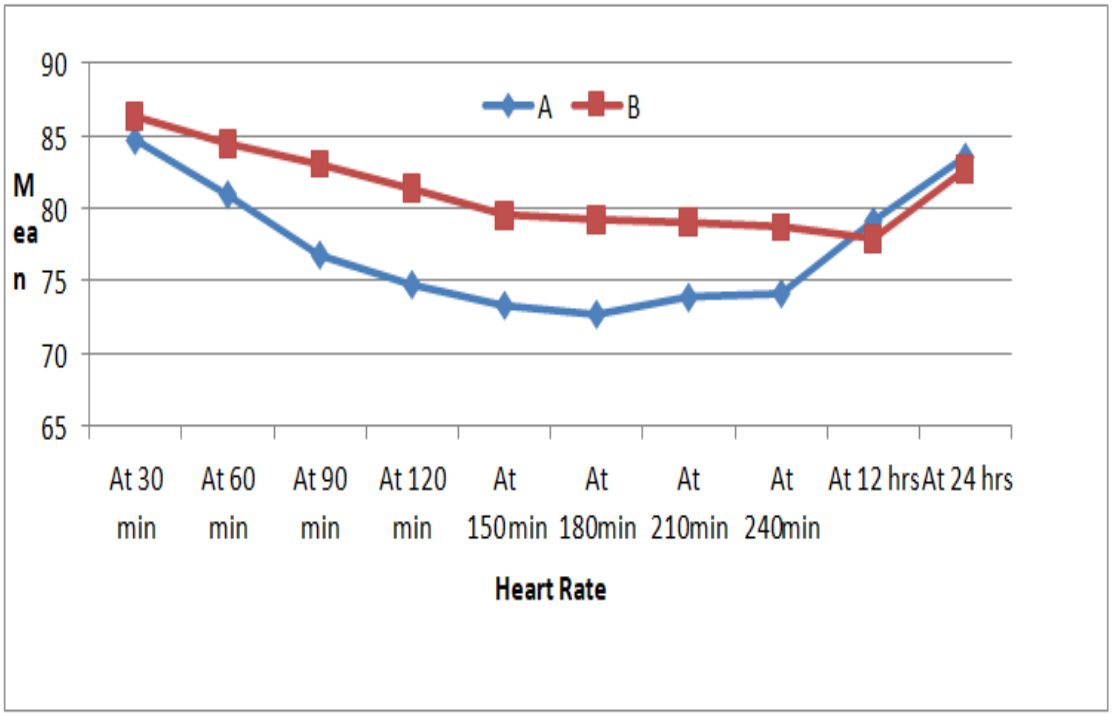


The patients are compared for the association between study group and HR

**Table 5: Association between Study Group and HR (N=60)**

| HR | GROUP A (n=30) | | GROUP A (n=30) | | P-value |
|---|---|---|---|---|---|
| | Mean | SD(±) | Mean | SD(±) | |
| At 30 min | 84.70 | 9.66 | 86.30 | 9.50 | 0.520 |
| At 60 min | 80.93 | 10.99 | 84.43 | 10.01 | 0.202 |
| At 90 min | 76.77 | 11.14 | 83.03 | 10.76 | <0.031* |
| At 120 min | 74.73 | 8.75 | 81.33 | 9.91 | <0.013* |
| At 150min | 73.30 | 8.75 | 79.53 | 9.32 | <0.010* |
| At 180min | 72.67 | 6.86 | 79.20 | 9.22 | <0.003* |
| At 210min | 73.87 | 7.26 | 79.00 | 8.85 | <0.017* |
| At 240min | 74.13 | 6.76 | 78.70 | 8.76 | <0.028* |
| At 12 hrs | 79.10 | 7.46 | 77.90 | 7.52 | 0.537 |
| At 24 hrs | 83.53 | 7.41 | 82.67 | 7.25 | 0.649 |
| **Unpaired T- Test, P Value *Significant** | | | | | |

**Graph 5: Line diagram for comparison of Groups A & B with HR**

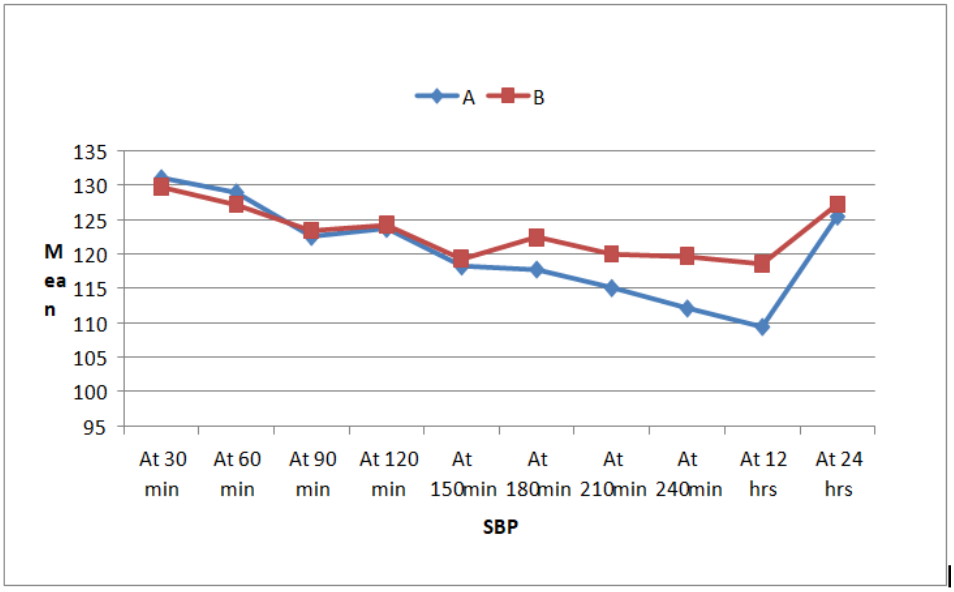



Patients are compared for the association between study group and SBP in the following table

**Table 6: Association between Study Group and SBP (N=60)**

| SBP | GROUP-A (n=30) | | GROUP-B (n=30) | | P-value |
|---|---|---|---|---|---|
| | Mean | SD(±) | Mean | SD(±) | |
| At 30 min | 131.07 | 7.839 | 129.70 | 7.747 | 0.500 |
| At 60 min | 128.93 | 8.706 | 127.17 | 8.292 | .424 |
| At 90 min | 122.53 | 19.744 | 123.37 | 18.758 | 0.867 |
| At 120 min | 123.70 | 7.475 | 124.20 | 8.306 | 0.807 |
| At 150min | 118.23 | 18.425 | 119.27 | 21.190 | 0.841 |
| At 180min | 117.73 | 7.515 | 122.43 | 9.066 | <0.033* |
| At 210min | 115.07 | 8.191 | 119.97 | 8.556 | <0.027* |
| At 240min | 112.13 | 8.740 | 119.63 | 9.008 | <0.002* |
| At 12 hrs | 109.40 | 8.418 | 118.53 | 9.486 | <0.000* |
| At 24 hrs | 125. 47 | 5.380 | 127.20 | 6.661 | 0.272 |
| **Unpaired T- Test, P Value *Significant** | | | | | |

**Graph 6: Line diagram for comparison of Groups A & B with SBP**

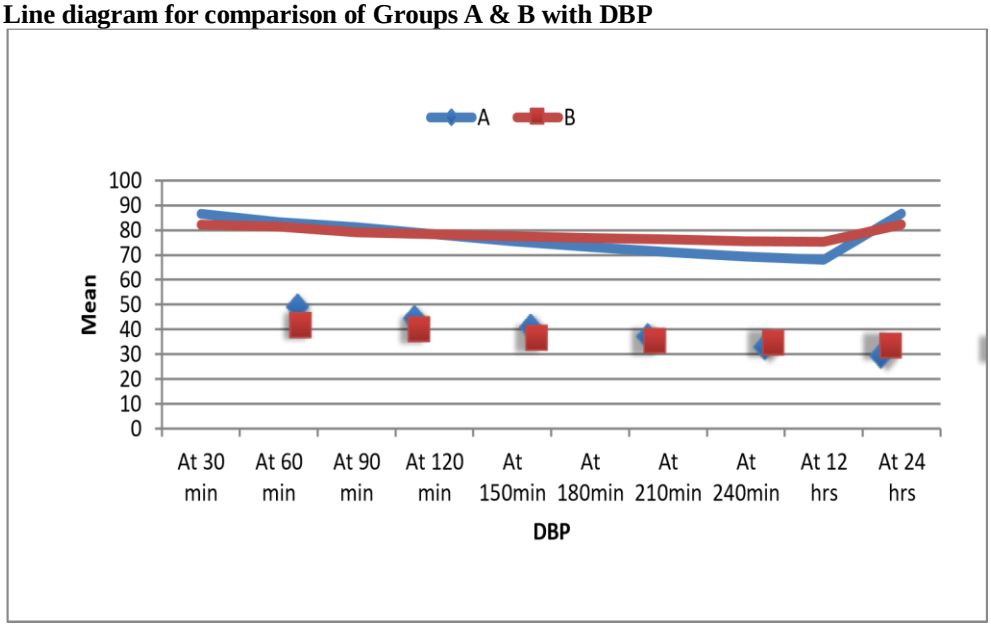



The patients are now compared for the association between study group and DBP in the following table

**Table 7: Association between Study Group and DBP (N=60)**

| DBP | GROUP A (n=30) | | GROUP B (n=30) | | P-value |
|---|---|---|---|---|---|
| | Mean | SD(±) | Mean | SD(±) | |
| At 30 min | 86.47 | 10.827 | 82.27 | 13.159 | 0.182 |
| At 60 min | 83.33 | 9.607 | 81.33 | 12.645 | 0493 |
| At 90 min | 81.07 | 9.461 | 79.03 | 13.389 | 0.500 |
| At 120 min | 78.37 | 9.835 | 78.30 | 11.891 | 0.981 |
| At 150min | 75.63 | 8.880 | 77.63 | 12.923 | 0.488 |
| At 180min | 73.23 | 8.943 | 76.83 | 12.839 | 0.213 |
| At 210min | 71.23 | 8.537 | 76.20 | 11.633 | 0.064 |
| At 240min | 69.27 | 8.733 | 75.63 | 12.113 | <0.023* |
| At 12 hrs | 68.07 | 8.509 | 75.33 | 12.053 | <0.009* |
| At 24 hrs | 86.70 | 9.319 | 82.30 | 10.780 | 0.096 |
| **Unpaired T- Test, P Value *Significant** | | | | | |

**Graph 7: Line diagram for comparison of Groups A & B with DBP**

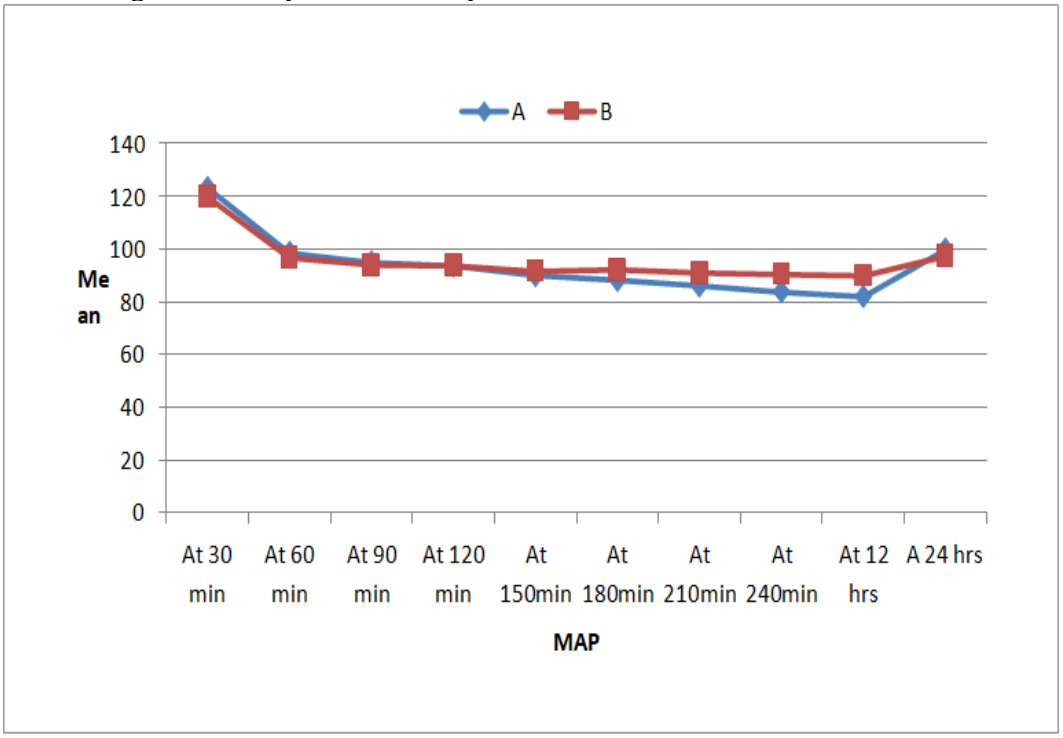


The patients are compared for the association between study group and MAP in the following table

**Table 8: Association between Study Group and MAP (N=60)**

| MAP | GROUP- A (n=30) | | GROUP- B (n=30) | | P-value |
|---|---|---|---|---|---|
| | Mean | SD(±) | Mean | SD(±) | |
| At 30 min | 123.18 | 9.821 | 119.69 | 11.408 | 0.210 |
| At 60 min | 98.53 | 8.536 | 96.61 | 10.320 | 0.435 |
| At 90 min | 94.89 | 9.754 | 93.81 | 12.491 | 0.711 |
| At 120 min | 93.48 | 8.026 | 93.60 | 9.589 | 0.957 |
| At 150min | 89.83 | 10.397 | 91.51 | 12.169 | 0.568 |
| At 180min | 88.07 | 7.176 | 92.03 | 10.347 | 0.90 |
| At 210min | 85.84 | 7.222 | 90.79 | 9.362 | <0.026* |
| At 240min | 83.56 | 7.675 | 90.30 | 10.151 | <0.005* |
| At 12 hrs | 81.84 | 7.699 | 89.73 | 10.219 | <0.001* |
| A 24 hrs | 99.62 | 7.174 | 97.27 | 8.662 | 0.256 |
| **Unpaired T- Test, P Value *Significant** | | | | | |

**Graph 8: Line diagram for comparison of Groups A & B with MAP**

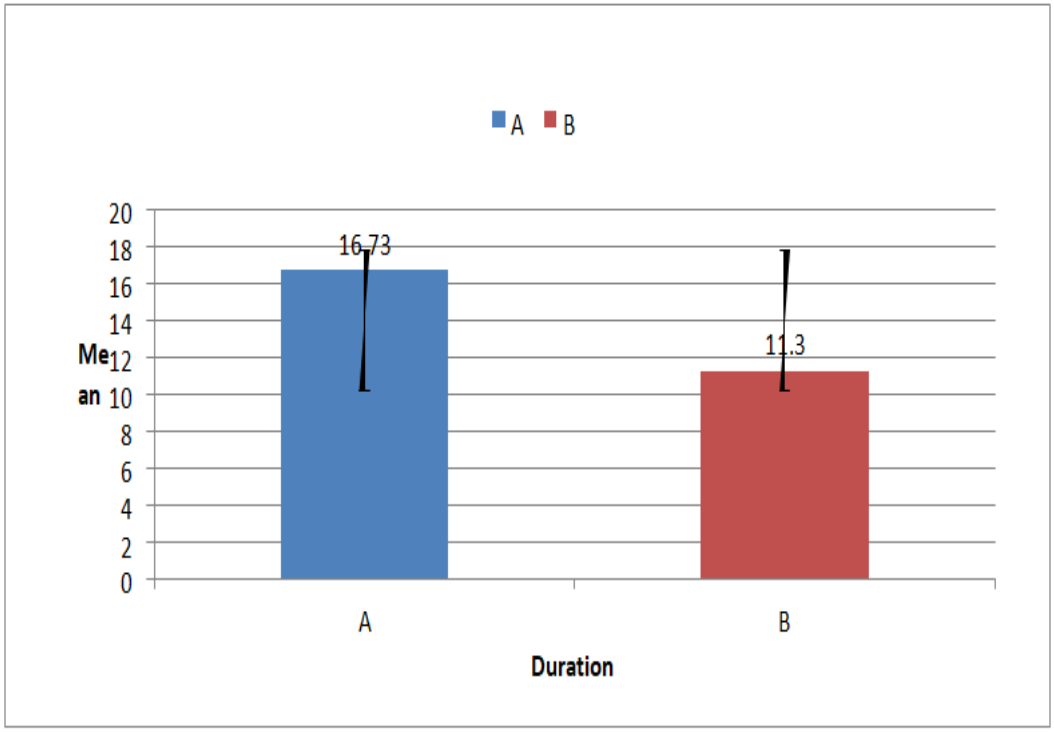



The patients are compared for the association between the study groups and the duration of analgesia in the following table

**Table 9: Association between Study Group and Duration (N=60)**

| Duration | GROUP A (n=30) | | GROUP B (n=30 | |
|---|---|---|---|---|
| | Mean | SD(±) | Mean | SD(±) |
| | 16.73 | 1.14 | 11.3 | 1.15 |
| **Unpaired t Test, P Value=0.000, significant** | | | | |

**Graph 9: Bar diagram for comparison of Groups A & B with Duration**

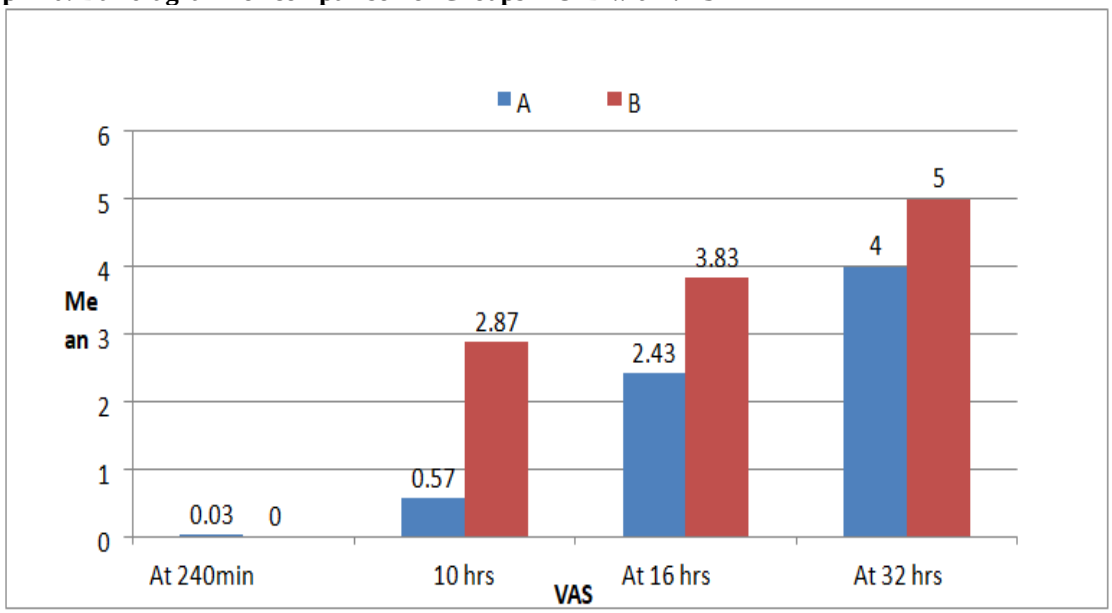



The patients are compared for the association between study groups and VAS in the following table

**Table 10: Association between Study Group and VAS (N=60)**

| VAS | GROUPA | | | GROUPB | | | P-value |
|---|---|---|---|---|---|---|---|
| | Mean | SD(±) | Median | Mean | SD(±) | Median | |
| At 240min | 0.03 | 0.183 | 0.00 | 0.00 | 0.000 | 0.00 | <0.5* |
| 10 hrs | 0.57 | 0.728 | .00 | 2.87 | 0.346 | 3.00 | <0.000* |
| At 16 hrs | 2.43 | 0.568 | 2.00 | 3.83 | 0.379 | 4.00 | <0.000* |
| At 32 hrs | 4.00 | 0.000 | 4.00 | 5.00 | 0.000 | 5.00 | <0.000* |
| **Chi-square Test, P Value *Significant** | | | | | | | |

**Graph 10: Bar diagram for comparison of Groups A & B with VAS**

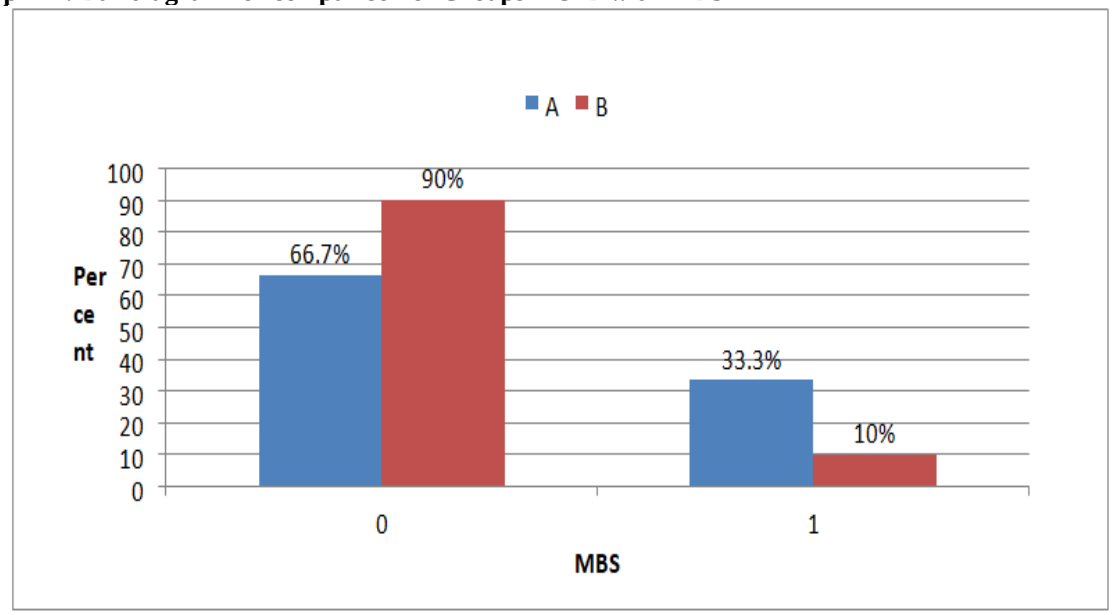


The patients are compared for the association between study group and MBS in the following table

**Table 11: Association between Study Group and MBS (N=60)**

| MBS | GROUP- A | | GROUP- B | |
|---|---|---|---|---|
| | (n=30) | n (%) | (n=30) | n ( %) |
| 0 | 20 | 66.7% | 27 | 90.0% |
| 1 | 10 | 33.3% | 3 | 10.0% |
| Chi-Square Test, P Value=0.05, Significant | | | | |

**Graph 11: Bar diagram for comparison of Groups A & B with MBS**

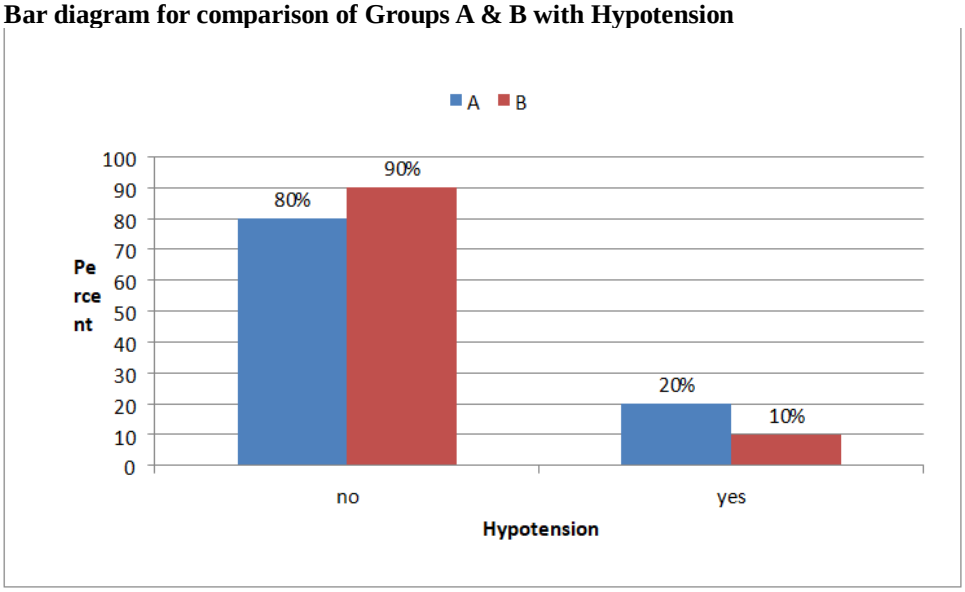



The patients are now compared for the association between study group and hypotension in the following table

**Table 12: Association between Study Group and Hypotension (N=60)**

| Hypotension | GROUP -A | | GROUP -B | |
|---|---|---|---|---|
| | (n=30) | n (%) | (n=30) | n ( %) |
| no | 24 | 80.0% | 27 | 90.0% |
| yes | 6 | 20.0% | 3 | 10.0% |
| Chi-Square Test, P Value=0.28,not Significant | | | | |

**Graph 12: Bar diagram for comparison of Groups A & B with Hypotension**

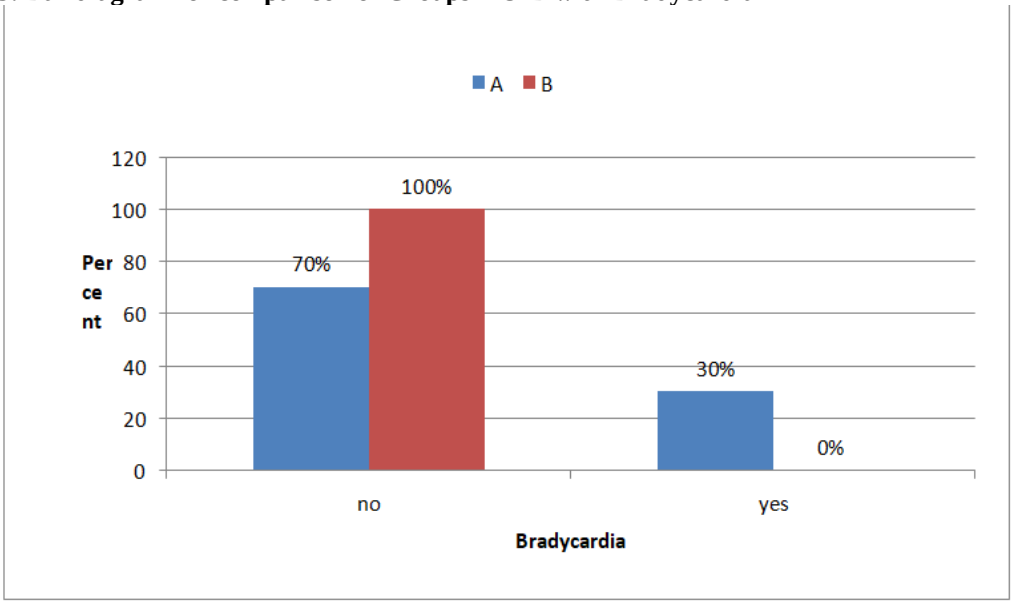


The patients are compared for the association between study group and Bradycardia in the following table

**Table 13: Association between Study Group and Bradycardia (N=60)**

| Bradycardia | GROUP A | | GROUP B | |
|---|---|---|---|---|
| | (n=30) | n (%) | (n=30) | n (%) |
| no | 21 | 70.0% | 30 | 100.0% |
| yes | 9 | 30.0% | 0 | 00.0% |
| Chi-Square Test, P Value=0.001, Significant | | | | |

**Graph 13: Bar diagram for comparison of Groups A & B with Bradycardia**




## DISCUSSION

With a P value of 0.342 Age distribution has no statistical significance. With a a P value of 0.5 Gender distribution has no statistical significance. With a P value of 0.959ASA physical status has no statistical significance.With a P value of 0.574 Weight distribution has no statistical significance. Adverse events like Hypotension with P value of 0.28 has no statistical significance.

**Heart rate ( HR )-** In Group-A among 30 patients, the HR is maximum at 30 minutes with a mean (SD) of 84.70 (±9.66). in Group-B among 30 patients, the HR is maximum at 30 minutes with a mean (SD) of 86.30 (±9.50). P value is statistically significant.

**Systolic blood pressure ( SBP )-** In Group-A among 30 patients, the SBP is maximum at 30 minutes with a mean (SD) of 131.07 (±7.839). In Group-B among 30 patients the SBP is maximum at 30 minutes with a mean (SD) of 129.07 (±7.747). P value is statistically significant.

**Diastolic blood pressure (DBP )-** In Group-A among 30 patients, the maximum DBP is observed at 30 minutes with a mean (SD) of 86.47 (±10.827). In Group-B among 30 patients, the maximum DBP is observed at 30 minutes with a mean (SD) of 82.27 (±13.159). P value is statistically significant.

**Mean arterial pressure ( MAP )-** In Group-A among 30 patients the maximum MAP is observed at 30 minutes with a mean (SD) of 123.18 (±9.821). In Group-B among 30 patients, the maximum MAP is observed at 30 minutes with a mean (SD) of 119.69 (±11.408). P value is statistically significant.

**Visual analog scale ( VAS )-** In Group-A among 30 patients, VAS is maximum at 16 hours with a mean (SD) of 2.43 (±0.568) and a median of 2.00. In Group-B among 30 patients, VAS is maximum at 16 hours with a mean (SD) of 3.83 (±0.379) with a median of 4.00. P value is statically significant.

**Modified bromage scale ( MBS )-** In Group-A among 30 patients, the MBS score is 0 in 20 (66.7%) patients and 1 in 10 (33.3%) patients. In Group-B the MBS score is 0 in 27 (90.0%) patients and 1 in 3 ( 10% ) patients. P value is statistically significant.

**Bradycardia-** In Group-A among 30 patients, 21 (70%) patients reported no signs of bradycardia and 9 (30%) patients developed bradycardia. In Group-B among 30 patients, 30 patients (100%) patients reported no signs of bradycardia.

From the above observations and inferences, it is demonstrated that equivalent doses of Dexmedetomidine is a better adjuvant to Bupivacaine in femoral nerve block forPostoperative analgesia after unilateral total knee replacement.

## CONCLUSION

In conclusion, all these above results suggest that adding Dexmedetomidine as an adjuvant to 0.25% Bupivacaine in femoral nerve block prolongs duration of analgesia without significant increase in the degree of motor blockade during postoperative period in

unilateral total knee replacement. Although bradycardia, hypotension are associated with dexmedetomidine, they were easily reversed. It also decreased the use of opioids and other modes of rescue analgesia.

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