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Continuous Spinal Block in Geriatric Total Hip Prosthesis Operations: Old Friend Spinal Catheter

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Abstract:

Introduction: *In geriatric patients with comorbid diseases undergoing orthopaedic surgery, central block applications rather than general anesthesia are generally used in an attempt to reduce morbidity and mortality risks associated with postoperative complications. The aim of this study was to compare the two different central block methods of continuous spinal anesthesia and combined spinal-epidural anesthesia applied topatients aged >65 years of ASA ≥IIIwho underwent planned total hip arthroplasty due to a femur fracture.*

Material and Method: *The study included 40 consecutive patients aged >65 years of ASA ≥III who were planned to undergo total hip arthroplasty because of a femoral fracture with central block anesthesia.Approval for the study was granted by the Local Ethics Committee. The patients were divided into two groups of 20 patients as the continuous spinal anesthesia group (Group I) and the combined spinal-epidural anesthesia group (Group II). The central block interventions were made from the L3-4 interval. Group I were administered 2.5 mg of 0.5% isobaric bupivacaine from a spinal catheter. An epidural catheter was attached to patients in Group II and spinal anesthesia was administered of 7.5 mg 0.5% isobaric bupivacaine. The block activity was evaluated using the Bromagescale and pinprick test, and the peak times were recorded. Vital parameters, motor and sensory block levels, VAS and Ramsey sedation scores were recorded during and after the operation. After removal of the catheters due to possible risk of infection depending on the length of stay, the ends were cut in a sterilized manner and sent for culture study. Statistical analyses of the data were made using the Student's t-test and the Mann-WhitneyU-test.*

Results: *No statistically significant difference was found in the demographic data. Statistically significant differences were found betweenpreoperative and postoperativeheart rates in Group II. There was a statistically significant difference between the groups in terms of motor and sensory block peak durations, sensory block level, and motor block grades.There was a statistically significant difference between the preoperative and postoperative VAS and Ramsey scores of the groups.*

Conclusion: *It was seen that the use of continuous spinal anesthetic and local anesthetic drugs in geriatric patients was significantly less and titrable. It was concluded that this technique can be used safely in geriatric patients as hemodynamic stability is protected.*

Keywords: Geriatric patient, central block, spinal catheter, continuous spinal anesthesia.

1. INTRODUCTION

Aging is an inevitable process, but the average lifespan has extended throughout the world with developments in technology. Mortality in hip and lower extremity orthopedic surgery is high in geriatric patients due to limited physiological adaptation capacity and the embolic risks of patients. In elderly patients, it is attempted to overcome anesthesia-related mortality and possible complications with various central and peripheral block applications. Regional anesthesia is preferred instead of general anesthesia in lower extremity surgical interventions of geriatric cases for reasons such as the patient remaining conscious, preservation of pulmonary functions, no intubation requirement, lowerrisk of thromboembolism, less surgical bleeding, the provision of postoperative analgesia, and low cost[1,2].Spinal anesthesia can be applied continuously with the placement of a catheter in the subarachnoid space. In many studies, continuous spinal anesthesia has been compared with other central block methods and continuous spinal anesthesia has been shown to result in minimal change in hemodynamic parameters and to be beneficial in postoperative acute pain management[3].

The aim of this study was to compare the hemodynamic effects of the two different central block methods of continuous spinal anesthesia and combined spinal-epidural anesthesia in the preoperative and postoperative periods and the sensorial and motor block qualities in patients over 65 years of age, who

were planned to have total hip prosthesis due to a femur fracture and were classified as ASA (American Society of Anesthesiologists) III and above according to the risk classification, in terms of complications, side effects, postoperative analgesia quality, and the risk of catheter-related infection.

2. MATERIAL AND METHOD

The study included 40 consecutive ASA ≥III patients aged > 65 years who were planned to undergo total hip arthroplasty due to femur fracture with central block anesthesia. Approval of the study was granted by the Ethics Committee of Bakırköy Dr. Sadi Konuk Training and Research Hospital. The patients were randomly divided into two groups of 20 patients as the Continuous Spinal Anesthesia group (Group I) and the Combined Spinal-epidural Anesthesia group (Group II). Patients with hypovolemia, coagulation defect, local infection in the surgical area, and headache or allergy history were excluded from the study. The use of bleeding diathesis drugs was stopped 7 days before the operation.Nopremedication was applied. Intravenous (iv.) ringer lactate solution (20 ml/kg) was used for hydration. The pre-operative hemodynamic parameters, SpO2 (oxygen saturation), Ramsey score, and VAS (Visual Analogue Scale) values were recorded. The patient was placed in the lateral decubitus position with the fractured lower extremity uppermost. Asepsis and antisepsis were ensured with povidone-iodine in the region of intervention. Local anesthesia of 2.5 cc 2% lidocaine was applied subcutaneously. Regional anesthesia was applied atthe L3-4 spinal segment in both groups. In Group I, the epidural space was reached using the resistance loss method with an 18 G Toughy epidural needle. A 27 G spinal needle was inserted into the subarachnoid space through a 22 G catheter (Spinocath, B.Braun ®). When CSF flow was seen, the spinal needle was retracted and the catheter was advanced 2 cm into the subarachnoid space. Through the catheter, 2.5 mg (0.5 cc) of isobaric bupivacaine (0.5% Marcaine, Abbott, USA) was administered. The procedure was completed with the fixation of the catheter.

The operating table was adjusted to 30° flexion. In Group II, the epidural space was reached using the resistance loss method with an 18 G Toughy epidural needle. A 27 G spinal needle was inserted into the subarachnoid space through the epidural needle (Escopan, B.Braun®).When CSF flow was seen, the spinal anesthesia procedure was completed by administering 7.5 mg (1.5 cc) isobaricbupivacaine. The spinal needle was retracted and then the 20 G epidural catheter was advanced 4 cm through the epidural needle and fixed. The sensory block level was targeted at the T8 level. The heart rate, systolic-diastolic arterial pressure, SpO_2, VAS score, and Ramsey sedation score were recorded every 3 minutes for the first 10 minutes, and every 5 minutes for the next 20 minutes. The sensory and motor block levels were checked. The hemodynamic parameters were recorded at 10-minute intervals after the first 30 minutes. The VAS score, Ramsey score, sensory and motor block levels were recorded at 30-minute intervals. Continuation of anesthesia in prolonged operations with the sensory block below the T8 dermatome level was planned with the addition of 0.5 ml of 0.5% isobaric bupivacaine via spinal catheter in Group I and with the addition of 5 ml of 0.5% isobaric bupivacaine via epidural catheter in Group II. Both groups were given 2 lt/min O2 via a mask in the preoperative period. Complications such as paresthesia, back pain, total spinal anesthesia, hypotension, bradycardia, tachycardia, allergy, nausea-vomiting, and shivering were recorded during the operation. At the end of the operation, postoperative pain control was planned for Group I with continuous infusion of 0.4 ml/s 0.5% isobaric bupivacaine through the spinal catheter in the first 24 hours after the operation. The postoperative pain control of Group II was arranged according to the VAS score. In cases with a VAS score of ≥3, a 3cc 0.5% isobaric bupivacaine and 2 cc saline bolus were planned to be administered through the catheter. In cases in both groups with a persistent VAS score>3 despite the postoperative acute pain control protocol, IV analgesia of the tenoxicam group non-steroidal anti-inflammatory drug was planned to be administered. The heart rate, systolic-diastolic arterial pressure, sensory block level, motor block level, VAS and Ramsey sedation scores were recorded at postoperative 1st, 3rd, 6th, 9th, and 12th hours, and the time of first micturition. Catheterization with a Foley catheter was planned for cases with micturition difficulty. Analgesia with hydration and caffeinated paracetamol was planned for the post-spinal headache. The catheters were retracted at the postoperative 24th hour. The retracted catheters were sent for culture analysis. Nausea-vomiting, micturition difficulty, headache, and allergic reactions were questioned. The demographic data were evaluated by the descriptive statistical method. The statistical significance of the obtained data was evaluated using the Student's t-test and the Mann-WhitneyU-test.A

value of p>0.05 was considered to be insignificant, p<0.05 to be significant, p<0.01 was significant at the advanced level, and p<0.001 was significant at the very advanced level.

3. RESULTS

No significant difference was found between the groups in terms of demographic data such as age, body mass index and gender in the descriptive statistics method. The demographic data are given in Table 1.

In Group I, the mean heart rate was 72.45±8.5/min before the operation, 69.40±8.8/min during the operation, and 70.55±8.5/min after the operation.No statistically significant difference was found between the heart rates before, during and 24 hours after the operation in Group I(p>0.05). In Group II, the mean heart rate was 85.5±14.9/min before the operation and 79.5±15.18/min after the operation. This group was found to have tachycardia before the operation. The postoperative mean heart rate of Group II was 74.8±13/min. The heart rates of Group II were found to be statistically very significantly high during the operation (p<0.001). When the heart rates of the two groups were compared in the postoperative period, it was determined that the heart rates of Group I were more stable.The heart rates of Group II at 24 hours postoperatively were found to be statistically highly significant (p<0.05).

The mean systolic artery pressure of Group II before the operation was 144.45±26.6 mmHg. The mean systolic artery pressure of Group II was 134.9±25.6 mmHg during the operation and 126±26 mmHg in the 24-hour period after the operation. A statistically significant decrease was determined in the systolic artery pressure values of Group II between the time periods (p<0.05). No statistically significant difference was found between the systolic artery pressure values of the two groups in the postoperative period (p>0.05). The diastolic artery pressure of Group I was 85±17 mmHg before the operation, 78.8±17 mmHg during the operation and 72.15±12.7 mmHg in the 24-hour period after the operation. There was no statistically significant difference between the diastolic artery pressure values of Group I (p<0.001). The mean diastolic artery pressure of Group II was 84.7±16.8 mmHg before the operation, 76±10.9 mmHg during the operation and 71.25±14.7 mmHg in the first 24-hour period after the operation and no statistically significant difference was found between these values (p<0.001). The SpO2 averages of Group I and Group II were 97% and there was no statistically significant difference between the groups in terms of SpO2 values (p>0.05). The preoperative and postoperative hemodynamic data of the groups are shown in Graphic 1 and Graphic 2.

In Group I, an average of 10 ml of local anesthetic was administered for both periods for anesthesia during the operation and analgesia after the operation. In Group I, the mean sensory block reached dermatome level T10 (T6-T12), and in Group II, this level was determined as T8 (T4-T12). There was a statistically significant difference between these two values (p<0.05). It was seen that the sensory block remained at a lower dermatome in Group I. When the sensory peak durations that lasted up to the highest dermatome reached by the sensory block were examined, it was seen thatthe mean peak duration was 15.95±5.5 min in Group I and 10.60±6.17 min in Group II.In Group I, the sensory block was determined to be statistically significantly longer (p<0.05). When the durations of two dermatome regressions were examined, it was seen that the mean duration was 45.75±14.91 min in Group I and 60.2±25 min in Group II.The sensory regression duration was determined to be statistically significantly shorter in Group I (p<0.05). After administration of local anesthetic into the spinal space, the time for the motor block to reach the first level of the Bromage scale was accepted as the start time of the motor block. The mean motor block start time was 7.9±4.3 min in Group I and 3.2±2.9 min in Group II. It was seen that the motor block start time was statistically significantly much shorter in Group II (p<0.01). The motor block completely disappeared at the 15th hour postoperatively in Group I, and at the 18th hour postoperatively in Group II, with no statistically significant difference determined between the motor block regression times of the groups (p>0.05). The preoperative and postoperative motor block values of the groups are shown in Graphic 3 and Graphic 4. The mean postoperative VAS score was 2 in Group I and 4 in Group II. The VAS values of Group I recorded after the operation were statistically significantly lower than those of Group II (p<0.05). When the VAS scale results in the postoperative period were evaluated, it was seen that the mean VAS score was 0.5 in Group I and 3 in Group II. The postoperatively recorded VAS values of Group I were found to be statistically significantly lower than those of Group II (p<0.05). In the evaluation of the Ramsey scores, no statistically significant difference was determined between the scores of the

groups in the preoperative and postoperative periods (p>0.05). The preoperative and postoperative VAS and Ramsey scores of the groups are shown in Graphic 5 and Graphic 6. The catheter cultures of both groups taken at the postoperative 24th hour were determined to be sterile. During the operation, hypotension developed in 1patient in Group I and in 3patients in Group II,which recovered with crystalloid replacement. In Group II, bradycardia (heart rate <60/min) was detected and recovered with 1 mg atropine. The mean ephedrine dose administered was 1.8±0.7 mg in continuous spinal anesthesia and 19.4±3.3 mg in single dose spinal anesthesia. Nausea and vomiting were not seen in either group during the operation, but nausea alone was detected in 3 patients in Group I.Postoperative micturition was observed atmean 3 hours in Group I, and at postoperative 4 hours in Group II. No statistically significant difference was seen between these values (p>0.05). No micturition difficulty was detected in any of the groups. No total spinal anesthesia or allergic reaction was seen in any patient in Group I or Group II. No complaints of headache were reported after spinal anesthesia.

4. DISCUSSION

Regional anesthesia practices are applied in an attempt to minimize morbidity and mortality rates and possible complications affected by the physiological adaptation capacity of geriatric patients.The study results showed a fall in arterial blood pressure in the combined spinal-epidural anesthesia group in the first 15minutes when the block level was highest, and hypotension was also observed in 2 patients with sensory block levels of T4 and T6. This observation was found to be consistent with Schnider's segmental block level theory and the views of some other authors.In the study by Schnider et al.of 50 patients, continuous spinal anesthesia was applied with 2.5–5 mg (0.5-1 cc) 0.5% isobaric bupivacaine and single dose spinal anesthesia with 20 mg (4cc) 0.5% isobaric bupivacaine through a 25 G catheter. A high spinal anesthesia level (above T6) was detected in 6 patients in the continuous spinal anesthesia group and in 17 patients in the single dose spinal anesthesia group. The continuous spinal anesthesia group was observed to remain hemodynamically more stable. It was argued that spinal anesthesia affects hemodynamic results positively with the titration of local anesthetics via the spinal catheter in continuous spinal anesthesia[4].Factors affecting hemodynamics are the anesthesia technique, and the type and density of local anesthesia.In a study by Favarel et al. performed with hyperbaric bupivacaine, continuous spinal anesthesia and the combined spinal-epidural anesthesia were compared and it was seen that there was no significant difference between the groups in terms of heart rate[5]. Shenkman et al. stated that anesthesia was well controlled with the use of low-dose local anesthetics in continuous spinal anesthesia and this was advantageous compared to other regional anesthesia methods and could therefore be used in elderly and high-risk patients. The maximal decrease in heart rate was reported as 7.2% - 11.7%. It was also reported that the level of sensory block in continuous spinal anesthesia could be carefully titrated and the risk of instability could be reduced hemodynamically[6]. Carpenter et al. found the incidence of bradycardia (heart rate <50/min) to be 13% in a study of 952 patients, and the bradycardia was attributed to decreased preload and the blockage of sympathetic cardio-accelerator fibers[7]. Collardet al. evaluated the hemodynamic changes in 2 patients with severe aortic stenosis who underwent hip surgery under spinal anesthesia and indicated that in these patients, excellent anesthesia without complicationscould be provided with local anesthetics given in small doses at intervals[8].Wilhelm et al. compared continuous spinal anesthesia with combined spinal-epidural anesthesia in traumatic patients and found that the heart rate was stable[9].Although there is usually no significant change in heart rate in spinal anesthesia,the incidence of decreased heart rate has been reported to be 10-15%[10].In the present study, although there was no statistically significant difference in heart rate during and 24 hours after the operation in Group I, where continuous spinal anesthesia was applied, patients in Group II with combined spinal-epidural anesthesia were found to be more tachycardic in the postoperative period.The difference in heart rate between the perioperative and postoperative periodsseen in Group II in the current study was consistent with the literature.An average of 10 ml of isobaric local anesthetic was administered to the group that received continuous spinal anesthesia preoperatively and during the 24-hour postoperative period, whereas the combined spinal-epidural anesthesia group was administered an average of 20 ml of local anesthetic. It was concluded that the use of local anesthetic drugs in titratable doses maintains the heart rate.Barnard et al. administered 0.5 ml hyperbaric bupivacaine to patients in spinal anesthesia performed at L3-4 space using a 28 G catheter combined with a 22 G spinal needle in 26

patients and observed hypotension in only 3 (11.5%) patients[11].Morton et al.reported more stable hemodynamics with local anesthetic infusion made with a 28 G catheter from the L2-3 spinal gap[12].In the present study, the average ephedrine dose was found to be lower in the continuous spinal anesthesiagroup [13].In a study by Gratadouret al.of patients who underwent spinal anesthesia, although the sensory block did not reach high levels, hypotension and bradycardia were observed in some patients.It was emphasized that these hemodynamic changes were due to an increase in parasympathetic activity[14].McCrea et al.found a lower frequency of hypotension in spinal anesthesia applied with the catheter method in geriatric patients and reported a lesser requirement for vasopressor during continuous spinal anesthesia[15].Since the local anesthetic was given at a lower dose and was titrated in the spinal catheter group, there was less change in arterial blood pressure values in Group I patients and the hemodynamic changes of the groups were found to be consistent with the literature.It was concluded that continuous spinal anesthesia is a safer method in geriatric patients with limited physiological adaptation.

In a study by Rigleret al., it was stated that the injection rate affected the local anesthetic distribution, with faster injection showing more uniform distribution of the solution, high segmental levels were provided, and the catheter diameter, the tip shape, the direction of the catheter tip, and the concentration of the local anesthetic solution were factors affecting the distribution.In that study, a comparison was made of the injection times of 20G catheter, 28G catheter and 25G spinal needle using 1 ml of fluid and the mean injection time was found to be 11.9±7.2 sec in 20G catheter, 9.8±2.6 sec in 25G needle and 52.6±17.2 sec in 28G catheter and it was reported that the 28 G catheter provided a more limited block[16].In another comparative study conducted using a 32G microcatheter and 0.5% bupivacaine with a 24G spinal needle, the level of analgesia was determined to be lower in continuous spinal anesthesia,with the mean level of analgesia at T10 (T12-T8) in the continuous spinal anesthesia group and T9 (T11-T5) in the single dose spinal anesthesia group and thedifference between the two groups was significant.The advantage of continuous spinal anesthesia was reported to be the distribution of local anesthetics and that the desired level could beachieved[17].King et al.reported that isobaric bupivacaine spinal anesthesia rarely reaches analgesia levels higher than T6 dermatome unless it is used in excessive volume and dose[18].In the present study, the mean sensory block level was found to be T10 in Group I, and T8 in Group II. Close similarities were determined between the literature data and the results of the current study. In another study, the segmental level of analgesia in the continuous spinal anesthesia group was lower than that of the single dose spinal anesthesia group and the analgesia duration was shorter in the continuous spinal anesthesia group.The mean analgesia duration was found to be 90±5 min in the continuous spinal anesthesia group and 158±6 min in the single dose spinal anesthesia group. The duration to reach T11 level was found to be 17±1.4 min in continuous spinal anesthesia and 9±0.6 min in single dose spinal anesthesia[19].In the present study, the duration to reach the T10 sensory level was 15.95±5.5 min for Group I and 10.60±6.17 min for Group II. In both groups, it was determined that the time to reach the sensory block level required for the operation was compatible with the literature.Petros et al.achieved sufficient sensory and motor blockage at 12-18 min with the administration of 0.5-2 ml 0.5% hyperbaric bupivacaine via a 28G catheter[20].In a study by Lawson andWillenis performed with 0.5% hyperbaric bupivacaine, it was stated that the lumbar space selection affected the timing of analgesia initiation but did not affect the final dermatome level of analgesia[21].Morrison et al. suggested that the major factor affecting the distribution of local anesthetics was the final position of the spinal catheter in the subarachnoid space[22].Standland Beckreported that the subarachnoid position of a 28G catheter was an important factor affecting the catheter efficacy when 0.5% isobaric bupivacaine was used and that it affected the timing of analgesia initiation and dose requirements[23].Standl et al. used a combined 28G catheter with 22G Quincke and Sprotte needles in a study related to the analgesia initiation time. Both groups were administered 2 ml of 0.5% isobaric bupivacaine and the analgesia initiation time on a 28 G catheter combined with a 22 G Sprotte needle was found to be shorter[24].Calleja et al.used continuous spinal catheter for analgesic purposes in 12 patients, in elective cesarean and uncomplicated birth, andreported that excellent analgesiawas achieved in 75% of the patients[25].Inthe present study, it was observed that the sensory and motor block peak times were compatible with the literature[22,23,25].In the present study, the low VAS score during and after the operation in Group I was thought to be due to the use of continuous infusion with less local anesthetic agent. It was concluded that the quality of analgesia in the

continuous spinal anesthesia group was consistent with the literature[25].Pappa et al. found contamination in 6 of the 100 spinal catheter tips that remained inserted for 24-72 hours, but no clinical infection was observed in any. In the present study, no reproduction was seen in any of the catheters sent for culture examination. The removal of the catheters in the first 24 hours postoperatively was found to play a role in achieving this result [27].Drasneret al.reported that the poor positioning of the catheter and the poor distribution of the drug may cause the extension of sacral-perianal anesthesia by limiting local anesthetic distribution[28].During or after lumbar intervention, complications such as paresthesia, continuous back and leg pain, numbness in the feet and legs can be seen usually localized on one side of the body. In a study of 12 patients, radicular pain was detected in 3 patients while moving the 32G catheter forward[29].In the present study, both groups were questioned about postoperative neurological complaints. No neurological complications, micturition difficulty or vomiting were detected after regional anesthesia in both groups.In the present study no total spinal block developed in any patient.

5. CONCLUSION

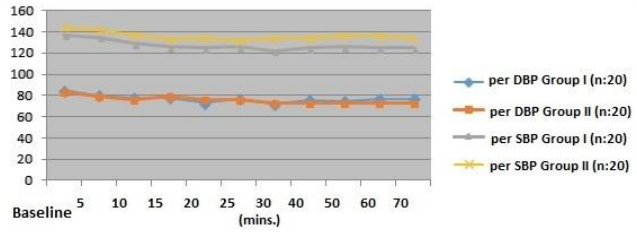
Since the local anesthetic agent can be titrated at a lower dose in elderly patients with unstable hemodynamics, continuous spinal anesthesia is superior to single-dose spinal anesthesia and combined spinal-epidural anesthesia. It also creates fewer cardiovascular and respiratory side effects. However, the application of this method requires technical experience. Continuous spinal anesthesia is an anesthesia technique that can be safely used to reduce hemodynamic disorders caused by the high sympathetic block in geriatric patients and the postoperative recovery period is shorter and uncomplicated.

Tables and Graphics:

Table 1. *Demographic data of the groups.*

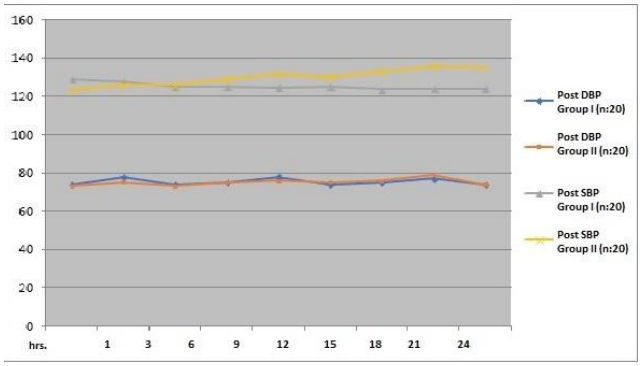
	Group I	Group II
Age (years)	73.40± 6.75	75.85 ±5.6
Body Mass Index (kg/m^2)	26±3.17	25.42±4.31
Gender (Female/Male)	11/9	10/10

Graphic 1. The perioperative systolic and diastolic blood pressure arterial pressures of the groups



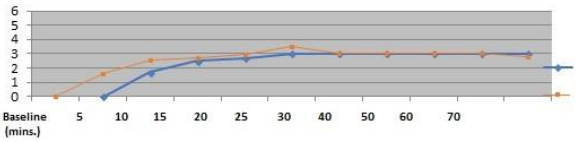
Per: Perioperative, DAB: Diastolic artery pressure, SAB: Systolic arterypressure

Graphic 2. Postoperative systolic and diastolic blood pressures of the groups

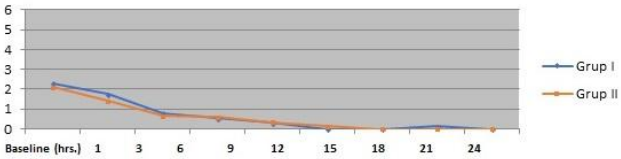


Post: postoperative, DAB: Diastolic artery pressure, SAB: Systolic artery pressure

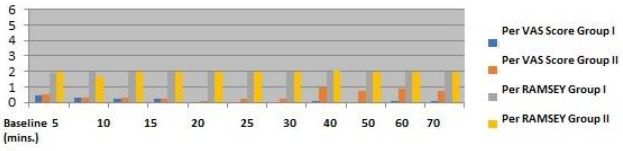
Graphic 3. Perioperative Bromage Scale of the Groups



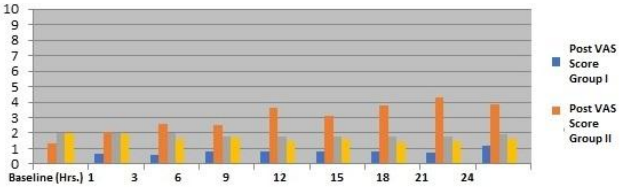
Graphic 4. Postoperative Bromage Scale of the groups



Graphic 5. Perioperative VAS and Ramsey scores



Graphic 6. Postoperative VAS Scoresand Ramsey Scores



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