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Comparative Study Between Hemi spinal Anesthesia with Fentanyl Versus Ultrasound Guided Combined Three in One Block Plus Sciatic Nerve Block in Overweight Patients Undergoing Total Knee Replacement

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ORIGINAL ARTICLE

Comparative Study Between Hemi-spinal Anesthesia With Fentanyl Versus Ultrasound-guided Combined Three-in-one Block Plus Sciatic Nerve Block in Overweight Patients Undergoing Total Knee Replacement

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Abstract

Background: **Due to the rising prevalence of knee arthritis at younger ages, total knee replacement (TKR) is one of the most common elective orthopedic surgeries worldwide. Many of the individuals having this procedure are obese.**

The purpose of this study was to assess the effects of sciatic nerve block with a combination of three-in-one block and hemi-spinal anesthesia during total knee replacement surgery.

Patients and methods: **Two groups: Group S (hemi-spinal anesthesia) and Group B of I, II, and III ASA patients having elective total knee replacement surgery were included in this observational study (combined three-in-one block and sciatic nerve).**

Results: **VAS was considerably lower in group B compared with group S at 2, 4, 8, 12, and 24 h compared with group S at PACU and at 1 h (*P* value 0.05). When compared with group S, group B considerably delayed the need for the first rescue analgesic (*P* value 0.001). When compared with group S, group B significantly consumed less morphine overall (*P* 0.001). The difference between group B and group S in terms of patient satisfaction was statistically significant ($P = 0.002$).**

Conclusion: **The combined three-in-one block and sciatic nerve block significantly improve the duration of analgesia in obese patients having total knee replacement surgery, hemodynamic changes, postoperative pain scores, patient satisfaction and ambulation, and adverse event rates. This allows analgesia providers to optimize their analgesic regimens for these patients.**

Keywords: Hemi-spinal, Knee replacement, Nerve block

1. Introduction

The primary total knee replacement (TKR) procedure is one of the most popular orthopedic elective procedures worldwide. Many of the people having this kind of treatment are obese.[1]

Obesity and total knee replacement are positively correlated. It is generally known that obese individuals get knee arthritis at an earlier age and are more likely to need a knee replacement. Joint pain can limit mobility and make it harder to tolerate exercise, all of which contribute to weight gain.[2]

Regional anesthetic is typically used to perform total knee replacements on elderly patients. Regional anesthetic has several advantages over general anesthesia, including higher patient satisfaction, fewer side effects (such as nausea, vomiting, and sore throat), a shorter time to discharge, and fewer issues with airway management. As a result, regional anesthetic techniques are used during total

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knee replacement surgery instead of general anesthetic.[3]

Particularly for patients undergoing unilateral lower limb surgeries, hemi-spinal anesthesia is advised. 'The practice of applying minimum doses of intrathecal drugs so that just the nerve roots supplying a specific location and only the modalities that require anesthesia are affected' is the definition of hemi-spinal anesthesia (HSA).[4]

Unilateral spinal anesthesia may have psychological benefits for healthy patients. The patient is spared from experiencing drug-induced reversible paraplegia as well as potentially feeling vulnerable due to immobility with a mostly unilateral block. The anesthetist attempts to avoid circulatory depression or decompensation in patients with cardiac risk. Unilateral spinal anesthesia can prevent a bilateral sympathetic block, and this method is typically hemodynamically advantageous.[5]

Although a combined three-in-one block and sciatic nerve block can be performed unilaterally during lower limb surgery, this technique is less common because it requires more time and a higher dosage of local anesthetic. A better technique is ultrasound-guided combined three-in-one block and sciatic nerve block, which has many benefits including fewer needle insertions, improved block performance, quicker administration, less local anesthetic dosage, and quick nerve blocking. Moreover, using ultrasound guidance prevents damage to nearby structures including arteries, veins, and nerves.[6]

It is crucial to investigate how being overweight affects the anesthesia technique because the incidence of being overweight during total knee replacement surgery is rising. It is still unknown how obesity affects spinal anesthesia. Furthermore, it is unclear if dosages of spinal anesthetics can be lowered in obese people.[7]

On the one hand, spinal anesthesia that lasts less time than the procedure is seen as a failure of the anesthetic. On the other side, a spinal anesthetic that lasts past the duration of the procedure may result in patient unhappiness, bladder problems, and/or lengthier hospital stays. It is crucial to look into how obese patients respond to the spinal anesthetic. Longer stays in the postoperative surgical unit and unanticipated hospitalizations can lead to delayed spinal anesthesia recovery, which can lead to unsatisfied patients and higher expenditures. To know whether being overweight impacts the anesthetic method, research is required.[8]

To determine which type of anesthesia is better for postoperative analgesia, maintains hemodynamic stability, and prevents postoperative complications, we will compare hemi-spinal anesthesia against combined three-in-one block and sciatic nerve block for total knee replacement surgery intraoperatively and postoperatively for 24 h.

2. Patients and methods

The patients in this comparative, prospective, randomized trial were those who were scheduled to undergo elective total knee replacement (TKR) surgery at Al-Azhar University Hospital and who fell into the physical status I, II, or III categories of the American Society of Anesthesiologists. In this study, 70 patients were included.

The Ethics Committee of the Faculty of Medicine at Al-Azhar University in Egypt gave its approval to the study. Each patient provided written informed consent. The confidentiality of the data and the participant's privacy are adequately protected.

2.1. Criteria of patient selection

Inclusion standards: Both sexes are present. Approximately 50–70 years old. Classification I, II, and III by the American Society of Anesthesiologists (ASA). BMI ranges between 27.5 kg/m^2 and 35 kg/m^2.

Exclusion standards: Patients who have a history of medication hypersensitivity. Emergency procedures abnormalities of coagulation and thrombocytopenia. Infection at the injection and needle insertion sites. Patients who have trouble assessing pain. One patient declined to take part in the investigation. Patients with neuropathy or a history of spinal surgery.

Blinding and randomization: Using a computer-generated sequence and sealed, opaque envelopes, patients were divided into two equal groups at random: Group S (hemi-spinal anesthesia) and Group B. (combined three–in–one block and sciatic nerve). Thirty-five patients make up each group (n = 35).

Group S: Hemi-spinal anesthesia was administered using a 25-G spinal needle and 2 ml (10 mg) of hyperbaric bupivacaine 0.5% and 0.5 ml (25 mcg) of fentanyl at the level of the lumbar L3-L4 for 15 min while the patient was seated.

Group B: Using a 40 ml mixture made up of 10 ml of 2.0 % lidocaine and 30 ml of 0.5% bupivacaine, the combined three-in-one block and sciatic nerve were performed with the help of ultrasound guidance in this group (30 ml in three-in-one block and 10 ml in sciatic nerve block).

2.2. Methods

2.2.1. Anesthetic techniques

Hemi-spinal anesthesia was administered to group S using a 25-G spinal needle to administer 2 ml (10 mg) of hyperbaric bupivacaine 0.5% and 0.5 ml (25 mcg) of fentanyl at the level of the lumbar L3-L4 while the patient was seated, followed by left or right lateral positions for 15 min.

2.2.2. Ultrasound-guided combined three-in-one block and sciatic nerve

The ultrasound equipment is across the patient's opposite side, and the operator is facing the patient from the side that was intended to be blocked. To improve operator access to the inguinal region, the table was flattened while the patient was in the supine position.

2.2.3. Three-in-one block (femoral nerve block)

The nerve was visible in cross section as a hyperechoic speckled triangular or oval-shaped structure just lateral to the artery after the patient was in the correct position; the skin was sterilized, the gel was applied to the Doppler Linear probe, and the probe was then placed on the inguinal area to allow visibility of the femoral artery and vein. It was injected with lidocaine 1 %2–3 ml. The femoral nerve was approached by inserting a 22-gauge, 150-mm insulated B-bevel needle (Stimuplex; BBraun, Boulogne-Billancourt, France) in-plane in a lateral-to-medial orientation. Up until the nerve site, it was introduced longitudinally to the ultrasonic beam (in-plane approach).

2.2.4. Sciatic nerve block (anterior approach)

The hip was abducted, externally rotated, and the knee flexed while the patients were in the same position until the calf and foot were exposed. To locate the sciatic nerve, the Doppler curved probe was positioned 8 cm distally to the inguinal crease, perpendicular to the skin. The lesser trochanter of the femur's lesser trochanter was located posterior and medial to the sciatic nerve. A 2 cc of 1 % lidocaine was injected. From the anteromedial to the posterolateral aspect of the thigh, a 22-gauge, 150-mm insulated B-bevel needle was inserted.

2.2.5. Measurements

Patient demographic information, vital signs, an evaluation of the patient's level of pain, and an evaluation of any postoperative sequelae were all documented.

Assessing postoperative analgesia is the main result.

Hemodynamic alterations, postoperative motor block, bladder function, side effects, patient satisfaction, and readiness for discharge are all considered secondary outcomes.

2.2.6. Sample size

Using the following information and the Epi-info program: 95 % test power and 95 % confidence level. Number of groups two: 33 % of group S's results and 77 % of group B's results. The needed sample size was a minimum of 70 individuals. A simple random sample is the type of sample.

2.3. Statistical analysis

The SPSS v27 statistical analysis program was used (IBM Inc., Armonk, NY, USA). Histograms and the Shapiro-Wilks test were used to assess the normality of data distribution. Unpaired Student's t-test was used to evaluate quantitative parametric data that were reported as mean and standard deviation (SD). The Mann–Whitney test was used to evaluate quantitative nonparametric data, which were reported as the median and interquartile range (IQR). When appropriate, qualitative variables were examined using the Chi-square test or Fisher's exact test and provided as frequency and percentage (%). Statistical significance was defined as a two-tailed *P* value of 0.05.

3. Results

At all time assessments, there was no statistically significant difference between the two groups' intraoperative heart rates or arterial blood pressure. Postoperative heart rate and arterial blood pressure were considerably lower in group B at 2, 4, 8, 12, and 24 h compared with group S (*P* value 0.05), whereas there was no statistically significant difference between the two groups at the PACU and at 1 h. At the PACU and 1 h, there were no appreciable differences between the two groups' VAS scores, but at 2, 4, 8, 12, and 24 h; group B's VAS score was considerably lower than group S's (*P* value 0.05). When compared with group S, group B considerably delayed the need for the first rescue analgesic (*P* value 0.001). When compared with group S, group B had considerably less overall morphine intake (Tables 1–7).

4. Discussion

Goyal et al.[9] conducted their study on 60 patients with anterior cruciate ligament (ACL) damage who were split into two groups: group 1 underwent

Table 1. Patient's demographic characteristics and duration of surgery in the studied groups.

	Group S ($n = 35$)	Group B ($n = 35$)	*P* value
Age (years)			
Mean ± SD	62.23 ± 4.86	60.17 ± 5.54	0.103
Range	52–71	51–72	
Sex			
Male	15 (42.86%)	18 (51.43%)	0.632
Female	20 (57.14%)	17 (48.57%)	
Weight (kg)			
Mean ± SD	96.34 ± 8.62	93.37 ± 8.29	0.146
Range	85–119	79–112	
Height (m)			
Mean ± SD	1.76 ± 0.06	1.74 ± 0.06	0.098
Range	1.65–1.87	1.62–1.84	
BMI (kg/m^2)			
Mean ± SD	31.07 ± 2.19	30.99 ± 2.77	0.893
Range	26.25–34.53	24.93–34.66	
ASA physical status			
ASA I	7 (20%)	9 (25.71%)	0.702
ASA II	17 (48.57%)	16 (45.71%)	
ASA III	11 (31.43%)	10 (28.57%)	
Duration of surgery (min)			
Mean ± SD	135.54 ± 8.29	134.31 ± 8.17	0.535
Range	121–148	120–149	

combination nerve blocks, while group 2 received spinal anesthesia. Their results are consistent with our findings. The findings demonstrated that group 1 patients had significantly lower pain scores.

In addition, 80 patients were enrolled in the Bhardwaj et al.[10] trial and were divided into two groups: those receiving spinal anesthesia and those receiving an ultrasound-guided combination sciatic and femoral nerve block. The outcomes showed that the combined sciatic and femoral nerve block performed under ultrasound guidance had lower

Table 2. Intraoperative heart rate (beats/min) changes in the studied groups.

	Group S ($n = 35$)		Group B ($n = 35$)		*P* value
	Mean	SD	Mean	SD	
Before induction	70.34	3.13	70.09	3.21	0.736
10 min	70.66	3.28	70.31	2.89	0.644
20 min	70.29	3.29	69.23	3.52	0.198
30 min	70.26	3.45	70.29	3.33	0.972
40 min	70.51	2.69	70.37	2.87	0.831
50 min	70.46	3.64	68.86	3.62	0.070
60 min	71.09	3.20	69.97	3.70	0.182
70 min	70.57	3.33	69.14	3.26	0.074
80 min	70.66	3.40	70.37	3.13	0.715
90 min	70.40	3.27	69.51	3.77	0.298
100 min	70.51	3.10	69.60	3.22	0.230
110 min	69.91	3.24	70.20	2.93	0.700
120 min	70.46	3.32	68.97	3.34	0.066
130 min	70.34	3.13	70.09	3.21	0.066
140 min	70.66	3.28	70.31	2.89	0.235
End of surgery	70.29	3.29	69.23	3.52	0.538

Table 3. Intraoperative mean arterial pressure (mmHg) changes among the studied groups.

	Group S ($n = 35$)		Group B ($n = 35$)		*P* value
	Mean	SD	Mean	SD	
Before induction	64.17	2.84	65.09	3.13	0.205
10 min	65.63	2.40	65.40	2.87	0.719
20 min	65.69	2.64	65.43	2.62	0.598
30 min	66.37	2.57	65.37	2.31	0.822
40 min	65.09	2.45	66.23	2.71	0.867
50 min	66.54	2.36	65.37	2.88	0.067
60 min	65.66	2.59	65.71	2.98	0.932
70 min	65.71	2.61	66.46	2.75	0.250
80 min	65.91	2.48	65.34	2.86	0.375
90 min	66.11	2.13	65.29	2.83	0.171
100 min	65.46	2.78	66.11	3.01	0.346
110 min	66.83	2.31	65.63	3.21	0.077
120 min	66.37	2.41	65.31	2.55	0.080
130 min	65.94	2.89	64.83	2.61	0.095
140 min	65.49	2.66	65.89	3.06	0.561
End of surgery	65.94	2.82	65.54	3.40	0.594

Table 4. Postoperative heart rate (beats/min) changes among the studied groups.

	Group S ($n = 35$)		Group B ($n = 35$)		*P* value
	Mean	SD	Mean	SD	
PACU	70.40	3.05	69.94	3.13	0.099
1 h	74.63	10.26	73.60	3.33	0.102
2 h	89.00	15.04	72.94	3.61	<0.001*
4 h	85.71	14.67	72.80	3.31	<0.001*
8 h	95.69	13.23	75.37	7.15	<0.001*
12 h	91.63	14.74	76.00	6.76	<0.001*
24 h	99.37	14.63	87.57	9.91	<0.001*

Table 5. Postoperative mean arterial pressure changes among the studied groups.

	Group S ($n = 35$)		Group B ($n = 35$)		*P* value
	Mean	SD	Mean	SD	
PACU	65.94	2.82	65.54	3.40	0.205
1 h	67.40	3.52	67.89	3.63	0.594
2 h	72.63	9.57	68.31	3.47	0.015*
4 h	73.03	9.90	68.34	3.72	0.011*
8 h	77.83	10.60	72.26	9.46	0.023*
12 h	80.89	10.87	74.23	10.95	0.013*
24 h	85.77	7.28	81.63	9.44	0.044*

Table 6. Visual analog scale (VAS) changes in the studied groups.

	Group S ($n = 35$)		Group B ($n = 35$)		*P* value
	Median	IQR	Median	IQR	
PACU	2	1–3	2	1–2.5	0.668
1 h	2	1–2	2	1–3	0.163
2 h	2	1.5–4	2	2–3	0.014*
4 h	3	2–3	2	1–3	<0.001*
8 h	4	3–5.5	3	2–3	<0.001*
12 h	3	2–5	2	1–3	0.026*
24 h	4	4–5.5	4	3–4	0.038*

Table 7. Time to first rescue analgesic requirement in the studied groups.

	Group S ($n = 35$)	Group B ($n = 35$)	P value
Time to first rescue analgesic requirement			
Mean ± SD	1.46 ± 0.51	8.23 ± 1.4	<0.001*
Range	1–2	6–10	

median VAS scores for postoperative pain assessment than spinal anesthesia (P 0.05).

Similar to our findings, Bhardwaj et al.[10] found that fewer patients required rescue analgesia in the sciatic and femoral nerve block groups treated with ultrasound guidance as compared with those treated with spinal anesthetic (P 0.001).

Further, the combination nerve block group and the spinal anesthetic group required equivalent amounts of postoperative analgesia for 24 h, according to Goyal et al.

Our findings were in opposition to those of Shokri and Kasem 10, who claimed that satisfaction ratings between the sciatic–obturator–femoral blocking group and the spinal anesthesia group were equivalent ($P = 0.562$).

4.1. Conclusion

To help analgesia providers optimize their analgesic regimens for obese patients having total knee replacement surgery, combined three-in-one block and sciatic nerve block significantly improve hemodynamic changes, longer duration of analgesia, lower pain scores postoperatively, better patient satisfaction scores, and ambulation with a lower incidence of an adverse event.

Disclosure

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Authorship

All authors have a substantial contribution to the article.

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Conflicts of interest

The authors declared that there were no conflicts of interest.

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