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Comparative Study between Ultra-Sound Guided Femoral Nerve Block and Adductor Canal Block in Postoperative Analgesia after Knee Arthroscopy

El-Feky, A A, Abdel Karim, U I, Ismael, A M
Anesthesiology and Intensive care department, Faculty of Medicine, Al-Azhar University

ABSTRACT

Background : Analgesia after knee operations can be achieved by integrated multimodal analgesic protocols using two or more analgesic modalities that work by different mechanisms that will optimize the analgesia and minimize the potential risks and side effects.

Objective: of this study was to evaluate the reliability of the postoperative pain control using adductor canal block (ACB) compared with that using the femoral nerve block (FNB) in patients undergoing knee arthroscopy.

Patients and Methods: Eighty patients who had been scheduled to knee arthroscopy were included in this prospective, blinded study, and were randomly allocated into two groups (40 each); A group, had received ACB and F group, had received FNB. After 15 minutes; sensation, motor power and vital signs are assessed, then patients transferred to operating room where all patients had received general anesthesia. Total intraoperative fentanyl and vital signs are assessed. The postoperative pain (numeric rating scale [NRS]) and quadriceps power were assessed in the postoperative care at (1, 2, 4, 6, 8, 10, 12, 18 and 24) hours. The time to 1st pethidine and total pethidine requirements were also recorded.

Results: Patients in group FNB had significantly less quadriceps power (at 6-8 h) postoperatively than those in groupACB. There were no significant differences between the two studied groups as regard NRS, time to 1st pethidine and total pethidine requirements in the 1st 24 h.

Conclusion: In patients undergoing knee arthroscopy, the ACB can maintain a higher quadriceps power compared with the FNB and is efficient as FNB in control of postoperative pain.

Keywords: Anesthetic techniques, adductor canal block, femoral nerve block, regional, bupivacaine, knee arthroscopy.

INTRODUCTION

Postoperative pain is an important consequence of knee surgeries that can affect early ambulation, range of motion and duration of stay in hospital. Advance surgical techniques like arthroscopies and early mobilization after surgery have made knee surgeries more patients friendly **(1).** Analgesia after knee operations can be achieved by integrated multimodal analgesic protocols using two or more analgesic modalities that work by different mechanisms that will optimize the analgesia and minimize the potential risks and side effects [(2)]. Numerous analgesic techniques were introduced aiming to minimize systemic narcotic usage which could reduce the incidence of known adverse reactions including tiredness, nausea, respiratory depression, decrease intestinal motility and urinary retention [(3)]**.**

Femoral nerve block (FNB) is commonly used in knee surgeries to control postoperative pain. The FNB is invariably associated with reduced quadriceps muscle strength and increased risk for fall. Consequently, with the FNB, the goal ofpain relief will compromise the goal of preserving the muscle strength. The ideal nerve block for knee surgeries should provide effective analgesia while preserving the muscle power to expedite the recovery [(4)]**.** The adductor canal block (ACB), which is relatively new block with high success rate. In contrast to FNB, ACB is predominantly a sensory block that preserves the quadriceps muscle strength with the favorable earlier mobilization than the FNB [(5)]**.** Ultrasound guidance has renewed interest in these blocks by allowing anesthesiologists to reliably place local anesthetic in the desired location and to avoid inadvertent needle trauma to surrounding structures [(6)].

The aim of the study was to compare the efficacy and safety of adductor canal block versus femoral nerve block in post-operative course for knee arthroscopy. The primary outcome was the time to first analgesic requirement. The secondary outcomes were pain score, motor affection, total analgesic requirements and incidence of complication.

PATIENTS AND METHODS

This Prospective, randomized, blinded, comparative study included a total of 80 patients scheduled for knee arthroscopy attending at AL-Azhar University Hospitals. Approval of the ethical committee and a written informed consent

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from all the subjects were obtained. This study was conducted between May 2017, and January 2018.

Patients were randomly allocated into two groups (40 each); A group, had received ACB and F group, had received FNB.

Inclusion criteria: American society of Anesthesiology (ASA) physical status I-II- III, age (20 – 50) years, patients of both sex and BMI ≤ 35.

Exclusion criteria: patients' refusal, bleeding disorders, skin lesions or wounds at site of proposed needle insertion, evidence of neuropathy or septicemia, known allergy to local anesthetics, history of psychological or neurological disorders, uncooperative patients and patients on chronic pain therapy.

Patients were submitted to the study after proper preoperative assessment including: previous history of general, local anesthesia or any medical diseases, clinical examination and proper investigations.

In pre-anesthetic room, an intravenous cannula (20 G) was inserted, midazolam (0.02 mg/kg). Oxygen 3 L/m through the nasal catheter was given through all the procedure. All patients received FNB (in group F) or ACB (in group A) using (Sonosite M turbo) ultrasound machine with linear probe 25mm and frequency 10-15 MHz 22-gauge, 100 mm lengths, short-bevelled echogenic needle and 15 ml of bupivacaine 0.5%. For the ACB, the US probe was placed at the mid-thigh level. The superficial femoral vessels were identified; deep to the sartorius muscle. The needle was advanced (using the in-plane technique from lateral to medial) toward the adductor canal where the local anesthetic was injected. For FNB, the US probe was placed on the inguinal crease, with a slight cephalic tilt, to identify the femoral artery and nerve. The needle was advanced (via the in-plane approach from lateral to medial) towards the femoral nerve where the local anesthetic was slowly injected. Adequate local anesthetic spread was confirmed in both techniques.

After completion of local anesthetic technique patients were hold in the preoperative room for 15 minutes then patients were transferred to the operating room and all patients received general anesthesia using propofol (2 mg/kg) and fentanyl (1µg/kg) and atracurium (0.5 mg/kg) were injected. The endotracheal tube (ETT)then was placed and cuffinflated. The patients were mechanically ventilated to maintain normocapnea (30-40 mmHg).The anesthesia was maintained using1. 2 % is ofluranedilutedin50 %oxygen mixed with air. Increments of atracurium (0.1 mg/kg) were used every 20 minutes.Fentanyl (0.25 µg/kg) were given when blood pressure or pulse increased more than 20% of the base and could be repeated every 5 minutes until pulse and blood pressure returned to within 20% more than the base. For the emergence from general anesthesia, atracurium was reversed, after return of adequate muscle power. The endotracheal tube was removed. Postoperatively, all patients received 30 mg ketorolac by iv infusion on 100 cm normal saline once they transferred to post-operative care unit (PACU) and repeated every 12 hours. Postoperatively, when patients requested analgesia or NRS>3, pethidine (20 mg) was administered intravenously and could be repeated after 20 minutes till NRS≤3.

All patients were assessed for: preoperative assessment; time of the technique: estimated from application of ultrasound probe to the skin till the end of local anesthetic injection, hemodynamics: heart rate (b/m), mean arterial blood pressure (mmHg) and oxygen saturation (%) were recorded before the technique as base line and at 5, 10 and 15 minutes after end of the technique, sensation using cold sensation test at 15 minutes after end of the block and the quadriceps muscle power were assessed by asking the patients (in the supine position) to perform a straight leg raise at 15 minutes after end of the block. the motor block was graded as follows: Grade 0, normal muscle power, Grade I, motor weakness, Grade II, complete motor paralysis[7]**.**Intraoperative assessment for total fentanyl requirements and hemodynamics before induction of general anesthesia, just after induction, 10 min, 20 min, 30 min, 60 min and at the end of the surgery. Postoperatively, the following were recorded: the postoperative pain using numeric rating scale (NRS) on this scale the patient choose a number from 0 to 10 that best describes their current pain**.** NRSat the rest and passive movement, recorded at(60 minute after transfer to PACU then at 2, 4, 6, 8, 10, 12, 18 and 24 h), total pethidine requirements in 24 hours, time for first analgesic requirement: measured from transfer of the patient to PACU till need the first dose of pethidine when [nrs>3], the quadriceps muscle power (60 minute after transfer of the patient to pacu then 2hr, 4hr, 6hr, 8hr, 12hr, 18hr and 24 hr),hemodynamics: heart rate (b/m), mean arterial blood pressure (mmhg) and oxygen saturation (%) at (just after transfer of the patient to pacu then 1hr, 2hr, 4hr, 6hr, 12hr, 18hr and 24 hr) and complications as hematoma or local anesthetic toxicity.

statistical analysis:

Data were analyzed using statistical program for social science (spss) version 15.0. quantitative data were expressed as mean± standard deviation (sd). qualitative data were expressed as frequency and percentage. The following tests were done:T test was used to compare between two means. Chi-square test (x^2): was used for comparing non-parametric data. Probability (p-value), p-value <0.05 was considered significant.

RESULTS

There was no statistically significant difference between the 2 groups of the study about their demographic data (age, sex, BMI and ASA classification) as shown in table (1).

Table (1): Patient characteristics.

Variable \ Groups		Group F (N = 40)	Group A (N = 40)	P-value
Age (year)	**Mean ± SD**	35.7±4.5	35.05±4.3	0.5
Sex	**Male**	24 (60%)	22 (55%)	0.6
	Female	16 (40%)	18 (45%)	
BMI (Kg/m^2)	**Mean ± SD**	24.3±3.8	25.1±3.8	0.3
ASA	**I**	27 (67%)	25 (62%)	0.7
	II	8 (20%)	11 (28%)	
	III	5 (13%)	4 (10%)	

There were no statistically significant difference between group F and group A as regards time of the technique with mean value (7.3±1.4 vs 6.9±1.1) min respectively, (p-value 0.2).

There were no statistically significant differences between group F and group A as regardspre, intra, and postoperative pulse, mean arterial blood pressure or oxygen saturation.

There was no statistically significant difference between the 2 groups of the study as regardspre-operative sensation at 15 minutes as shown in table(2), but quadriceps muscle power was significantly less in Group F if compared with Group A at 15 minutes as shown in table (2).

Table (2): Pre-operative sensation and quadriceps muscle power.

Variable \ Groups		Group F (N = 40)	Group A (N = 40)	p-value
loss of sensation		32 (80%)	35 (88%)	0.4
Quadriceps muscle power	**Grade 0**	4 (10%)	40 (100%)	**< 0.001**
	Grade I	17 (43%)	0 (0%)	
	Grade II	19 (47%)	0 (0%)	

There was no statistically significant difference between the 2 groups of the study as regardstotal fentanyl requirement as shown in table (3).

Table (3): Total fentanyl requirement.

Variable \ Groups		Group F (N = 40)	Group A (N = 40)	p-value
Total fentanyl (µg/kg)	**Mean±SD**	1.6±0.5	1.8±0.4	0.2

There was no statistically significant difference between the 2 groups of the study as regardsNumerical Rating Scale (NRS) at rest and at passive movement as shown in figure (1) and figure (2) respectively.

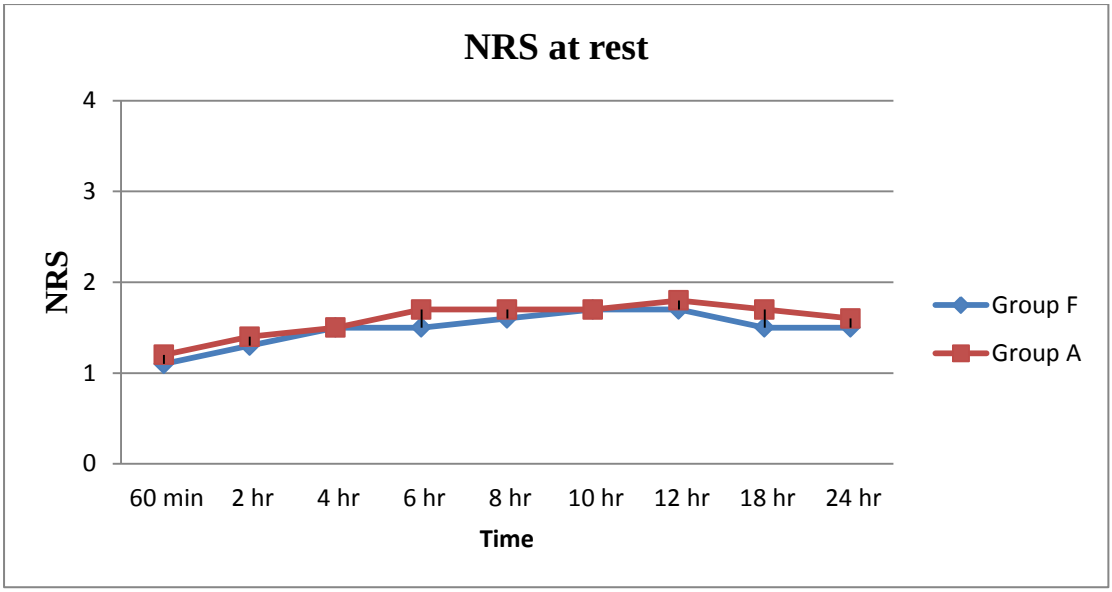

Figure (1) NRS at rest

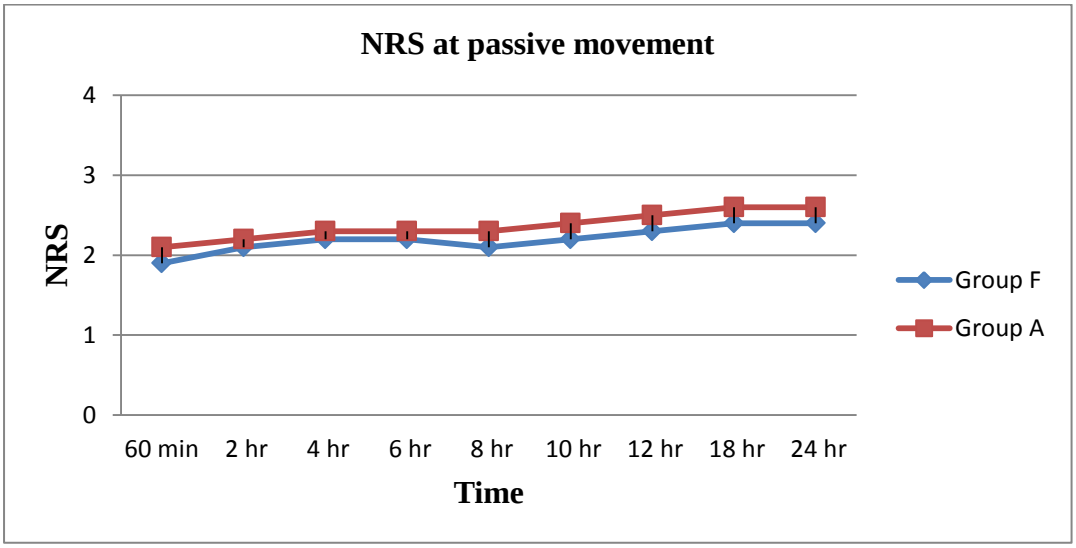

Figure (2): NRS at passive movement.

There was no statistically significant difference between the 2 groups of the study as regardstotal pethidine requirements in 24 hours post-operative as shown in table (4).

Table (4): Total pethidine requirements

Variable / Groups		Group F (N = 40)	Group A (N = 40)	p-value
Total pethidine (mg)	**Mean±SD**	78.0±25.01	79.0±23.4	0.9

There was significant statistically difference between the 2 groups of the study as regardspost-operative quadriceps muscle power as the muscle power was significantly less in Group F if compared with Group A at (60 minute after transfer to PACU, 2, 4 and 6 hrs.) post-operative as shown in figure (3).

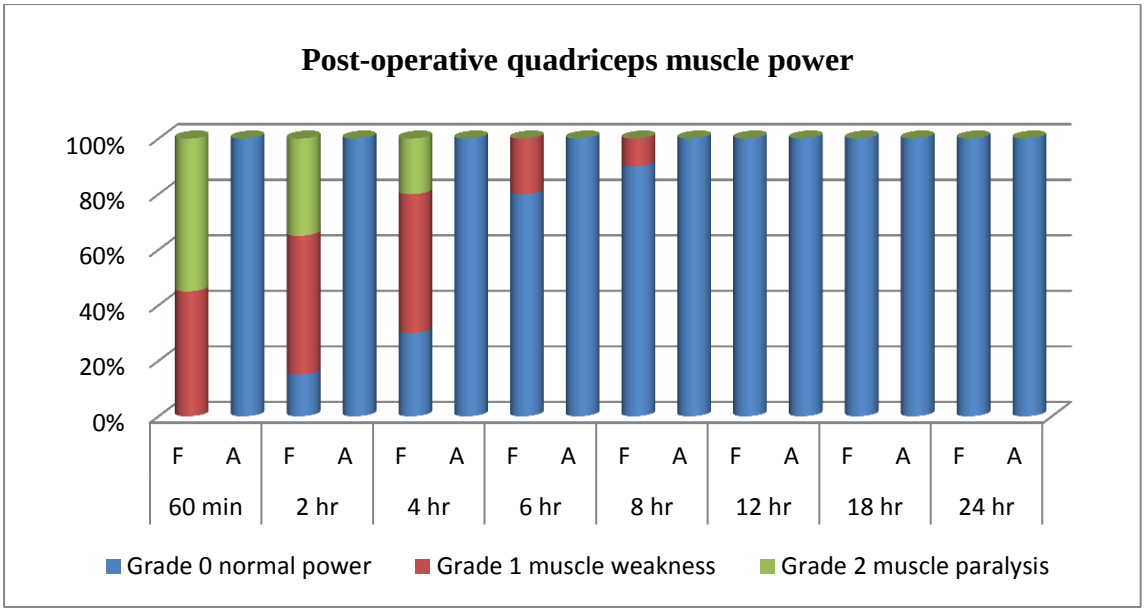

Figure (3): Post-operative quadriceps muscle power.

There was no statistically significant difference between the 2 groups of the study as regardstime to first pethidine requirement post-operative as shown in table (5).

Table (5): Time to 1st analgesia.

Variable \ Groups		Group F (N = 40)	Group A (N = 40)	p-value
Time to 1st analgesia (hrs)	**Mean±SD**	9.4±1.1	9.3±2.8	0.8

There was no statistical significant differencebetween the 2 studied groups as regard complications table (6).

Table (6):Complication

Complications \ Groups	Group F (N = 40)	Group A (N = 40)	p-value
Hematoma	0 (0%)	0 (0%)	------
Local anesthetic toxicity	0 (0%)	0 (0%)	------
Nausea	7 (17.5%)	8 (20%)	0.739
Vomiting	6 (15%)	7 (17.5%)	0.905

DISCUSSION

The adductor canal block has recently gained attention from anesthesia and orthopedic communities [8]. The desire to produce analgesia without loss of motor control to the thigh is beneficial. Benefits of this technique may include shorter hospital stays, earlier and more efficient rehabilitation, and pain control. This technique also embraces the emerging regional philosophy of selectivity or blocking only the area involved in the surgery [9].

In our study, there were no significant differences among the two studied groups as regard to demographic data, the first time to introduce analgesia, total analgesic consumptionand the mean value of NRS score in the 1st h.

While comparison of the mean value of quadriceps strength among the studied groups revealed that there was significant decrease of quadriceps strength in FNB till 6-8 h postoperatively in comparison with ACB.

In agreement with our results, **Hanson *et al.*** studied the effect of saphenous nerve block on postoperative pain control post menisectomy compared to placebo. They concluded that ACB decrease the pain score significantly at rest and activity in addition to improving patient comfort post-surgery. In these studies, opioid consumption was also significantly reduced with ACB than

placebo [10]. **Kwofie *et al.*** demonstrated that Quadriceps strength and balance scores were similar to baseline following ACB. Following FNB, there was a significant reduction in quadriceps strength (95.1% ± 17.1% vs 11.1% ± 14.0%; $P < 0.0001$) and balance scores (56 ± 0 vs 37 ± 17.2; $P = 0.02$) compared with baseline **[11].** **Kim *et al.*** in 2014, in the study comparing FNB versus ACB for TKA demonstrated that the ACB is an effective alternative to the FNB for patients undergoing TKA. The ACB exhibited significant sparing of the quadriceps strength at 6 to 8 h and was not inferior to the FNB regarding pain scores and opioid consumption[12].**Jaeger *et al*.** reported that FNB reduced 49% of quadriceps strength from baseline but ACB caused only 8% reduction in healthy young subjects. This 8% percentage is minor to cause risk of falls [5]. In controversy to our results, **Espelund *et al.*** concluded that there was no significant analgesic effect of the ACB after minor arthroscopic knee surgery with a basic analgesic regimen, that may be due to mild pain that could be overcome by basic analgesia [13].Furthermore, **El Ahl**, found that the VAS pain score and opioid consumption was significantly higher in patients received ACB than FNB .In his study the local anesthetic was ropivacaine 0.5% which is less potent than Bubivacaineand VAS score was measured only every 6 hours [14].

CONCLUSION

Ultrasound guided adductor canal block is efficient as ultrasound guided femoral nerve block in control postoperative pain in patients undergoing knee arthroscopy. Also ACB result in early mobilization with no risk of fall and preservation of quadriceps muscle that render ACB preferred.

RECOMMENDATIONS

ACB should be considered as a safe efficient alternative to FNB for postoperative pain in cases of knee arthroscopy.

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