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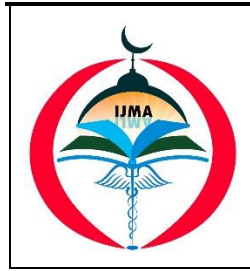
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## Original Article

# Ultrasound Guided Fascia Iliaca Block versus Adductor Canal Block for Postoperative Analgesia in Knee Arthroscopic Surgeries. "A prospective Comparative Randomized Clinical Study"

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## ABSTRACT

### Article information

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**Background:** Early rehabilitation after knee arthroscopic surgery is needed to improve functional recovery which is achieved by ideal analgesia.

**The aim of the work:** This study aimed to compare between safety and efficacy of fascia iliaca block [FIB] and adductor canal block [ACB] using ultrasound guidance for post-operative analgesia and motor affection of quadriceps muscle after knee arthroscopic surgeries.

**Patients and Methods:** Sixty patients of American Society of Anesthesiologist [ASA] I and II were included. They were scheduled for elective knee arthroscopic surgeries between April 2017 and October 2018. They were selected from Al-Azhar University Hospital [Damietta, Egypt]. They were randomly allocated to receive either FIB or ACB by bupivacaine 0.25 with ultrasound guidance. Their pain, and sensory block were assessed before and after procedure. The time for first analgesic request and total consumed analgesics were documented.

**Results:** At 30 minutes, 1, 2, 4, 6, 8, 12 and 24 hours, there were no significant differences among the mean value of Numerical Rating Scale [NRS] between FIB and ACB. The first time to introduce morphine and total morphine consumption showed no significant differences between FIB and ACB. There was significant motor affection of FIB in comparison with ACB.

**Conclusion:** FIB and ACB provided effective and safe postoperative analgesia for patients scheduled for knee arthroscopic surgeries, with sparing of quadriceps muscle strength and early ambulation in ACB patients.

**Keywords:** Fascia Iliaca Block; Adductor Canal Block; Post-Operative Analgesia; Knee Arthroscopy.



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## INTRODUCTION

Knee arthroscopy is one of the most commonly performed orthopedic procedures. It is an important diagnostic and therapeutic tool in the management of knee disorders<sup>[1]</sup>. Pain is a stress response of the body to damage and is not only a physiological response but also a

psychological reaction<sup>[2]</sup>. For optimal patient flow in day-case surgery departments, patients must be mobilized early after surgery. Therefore, effective pain treatment is crucial<sup>[3]</sup>.

Peripheral nerve blocks are associated with less pain and lower odds of unplanned hospital admission compared to systemic analgesia<sup>[4]</sup>.

Ultrasound increases the ability to confirm the local anesthetic spread around the target nerve [5] and clearly reveals the needle and the surrounding hazardous structures, including blood vessels. Therefore, the risk of systemic toxicity due to intravascular injection and peripheral neuropathy due to mechanical trauma and/or intra-neuronal injection should be diminished with ultrasound guidance [6].

Here we tested two modalities of nerve blocks under ultrasound guidance. We think it will add to the known literature to reach the ideal or optimal technique for analgesia.

### THE AIM OF THE WORK

The present study aimed to investigate the impact of ultrasound-guided FIB versus ultrasound-guided ACB on the postoperative analgesia and mobilization ability after arthroscopic knee surgery.

### PATIENTS AND METHODS

After approval of the Ethics and Research Committees, we conducted this prospective comparative randomized clinical trial. It included 60 patients of both sexes, ASA I or II, age ranged from 21 to 60 years. All were scheduled for elective knee arthroscopic surgery between April 2017 and October 2018. The were selected from Al-Azhar University Hospitals. The participation was only based on the complete acceptance of participants voluntarily. An informed written consent had been signed after description of the procedure steps.

We excluded all patients who refused sharing in the study. Also, patients with [coagulopathy, thrombocytopenia, sepsis, or infection at the puncture site], and those with history of preexisting neurological diseases, were excluded from the study.

Patients were divided randomly into two equal groups [n=30 in each]. **Group I [Group F]** for patients received fascia iliaca block achieved by injecting 20 ml of 0.25% bupivacaine guided by ultrasound. **Group II [group A]** for patients received adductor canal block achieved by injecting 10 ml of 0.25%

bupivacaine guided by ultrasound.

Preoperatively, all patients were assessed clinically and investigated for the exclusion of any contraindications. Laboratory workup included complete blood count [CBC], prothrombin time and concentration [PT & PC], partial thromboplastin time [PTT], renal function tests, and liver function tests.

Intraoperatively, 18 G intravenous line was inserted, and fluids were administered according to calculated dose. Heart rate, noninvasive arterial blood pressure, and oxygen saturation were recorded. Then, a standard protocol of general anesthesia included propofol 2 mg/kg, fentanyl 1 µg/kg and atracurium 0.5 mg/kg IV intubating dose and 0.1 mg/kg maintenance of muscle relaxation every 30 min or if needed. Intubation and mechanical ventilation maintain end-tidal CO<sub>2</sub> between 35-40 mmHg. The maintenance of general anesthesia with achieved by isoflurane 1%-2% MAC. The reverse of muscle relaxant by Atropine 20 µg/kg and Neostigmine 50 µg/kg IV bolus.

### Preparation for the block:

Twenty-two-gauge, 100 mm length, short beveled regional block needle was used. Skin antiseptic solution [0.5% Chlorhexidine spray], and sterile [gloves, towels, probe cover, and gel] were prepared and used.

For fascia iliaca block, 20 ml of 0.25% of bupivacaine, and for adductor canal block 10 ml of 0.25% bupivacaine were prepared. Portable ultrasound machine [SonoSite M-Turbo and 6–13 MHz linear probe] was used, while the patient was placed in the supine position, with the abducted and externally rotated thigh. The operator stood next to the side that was to be blocked and the ultrasound screen located on the opposite side, provided that, the ultrasound controls are comfortably within reach. The skin over the block site was sterilized with 0.5% chlorhexidine and the block started just after confirmation of tube position and fixation of it.

### Fascia Iliaca Block technique:

At the level of the inguinal crease, anatomical orientation begins by identifying the femoral

artery. If it was not immediately visible, sliding of the transducer laterally and medially was eventually brought the vessel into view. Once appeared, lateral and deep to the femoral artery and vein, a large hypoechoic structure was the iliopsoas muscle. It was covered by a hyperechoic fascia separating the muscle from the subcutaneous tissue superficial to it. A 100 mm, 20G needle was inserted in-plane from lateral to medial aiming to place the needle tip under the fascia iliaca and to deposit 20 mL of local anesthetic injected in increments until its spread laterally toward the iliac spine and medially toward the femoral nerve was observed with US visualization with intermittent aspiration every 5 ml.

### Adductor Canal Block technique:

At the level of the mid-thigh, anatomical orientation begins by identifying the adductor canal through the representation of the sartorius muscle, the femoral artery, and vein. The saphenous nerve appears as a hyperechoic structure situated lateral to the femoral artery. A 100 mm, 20G needle was inserted in-plane from lateral to medial aiming to place the needle tip close to the saphenous nerve. 10 ml of local anesthetic solution was incrementally injected in the adductor canal after initial aspiration followed by intermittent aspiration every 5 ml where the saphenous nerve looks like a floating bubble.

**Postoperatively:** After recovery, all patients were transported to the post-anesthesia care unit for 2 hours then transferred to the ward where the observation was completed after 24 hours. Any patient with NRS  $\geq 4$ , was managed by intravenous morphine, titrated by 3 mg increments and pain was assessed every 5 min until relief, which was defined as NRS < 4.

### Measured parameters:

1. Hemodynamics: heart rate [HR] and mean arterial pressure [MAP] were recorded preoperative, at skin incision, after 15, 30, 60 minutes, 2, 4, 6, 12 and 24 hours after block application.
2. Pain score: Pain assessment by the aid of Numerical Rating Scale [NRS] where pain

was assessed on an 11-points from 0 [no pain] to 10 [worst pain imaginable]. Patients were asked to choose the number that best corresponds to their pain intensity, and recorded postoperative after 30 minutes, 2, 4, 6, 8, 12 and 24 hours after block application.

3. Time [hour] to the first request of analgesia and booster dose and its efficacy.
4. Onset and duration [hour] of both sensory and motor block. The quadriceps muscle power was assessed while the patient in the supine position. They were requested to play out a straight leg raise. The quadriceps muscle power was assessed at 2, 4, 6, 8, 12 and 24 hours after performing the block. The quadriceps motor power was assessed using the Medical Research Council [MRC] scale and was graded as follows: grade 0= no voluntary contraction possible; grade 1 = muscle flicker, or trace of contraction but no movement of limb; grade 2=active movement only with elimination of the gravity, grade 3 = active movement against gravity but without resistance; grade 4 = active movement against gravity with some resistance; and 5= normal motor power against resistance [7].
5. Total opioid consumption [mg] in the first 24 hours.
6. Incidence of complications [hematoma, failure, allergy, and toxicity].
7. Patient's satisfaction the overall level of patient's satisfaction about the procedure and postoperative analgesia was assessed using four -point scale: 0 = poor, 1 = good, 2 =very good, 3 =excellent.

**Statistical analysis:** The collected and analyzed by Microsoft Office Excel [2016] [Microsoft® Inc., USA]. The numerical data [quantitative] were expressed as mean, with their standard deviations, when it obeys the normal distribution or by their median if it had an abnormal distribution. The independent sample student t-test was used for comparison between two means. The categorical [Qualitative] data were presented by frequency and percentages

and for comparison between groups, Chi-square [ $X^2$ ] test was used. For the interpretation of results, the  $p$ -value  $\leq 0.05$  was considered statistically significant.

**Randomization:** Patients were randomized into two groups by drawing sequentially numbered, coded, sealed, and opaque envelopes with a computer-generated allocation number. The sealed envelopes for the randomization were prepared by a research assistant who took no further part in the study.

## RESULTS

As regards demographic data [age, sex, weight and ASA] there were insignificant difference as shown in table 1. Hemodynamics [heart rate and mean arterial blood pressure], revealed non significant changes between studied groups. Mean values at different times are presented in table [2]. There was non

significant differences between both groups regarding NRS [Table 3].

In the group [F] the duration of sensory block ranged between 3 and 9 hours, with mean value  $[7.033 \pm 1.6]$ . however, in group [A], the duration ranged from 4 to 9 hours, with mean value  $[7.1 \pm 1.37]$  hours [ $p$  value  $> 0.05$ ]. the time for first analgesic request also did not differ significantly between groups. In the [F] group, the total opioid consumption ranged from 3 to 9 mg morphine [mean  $\pm$ SD was  $4.8 \pm 1.86$ ] while in [A] group, the total opioid consumption ranged between 3 and 9 mg morphine [mean  $\pm$ SD was  $4.46 \pm 1.87$  mg,  $p$  value  $> 0.05$ ]. The overall level of patient's satisfaction regarding the procedure and postoperative analgesia was assessed using the four-point scale in the [F] group ranged from [0 – 3] with a mean value  $[2.43 \pm 0.77]$  while in group [A], it ranged from [0 – 3] with a mean value  $[2.4 \pm 0.81]$ , and  $P$ -value  $> 0.05$ .

**Table [1]:** Comparison among the two groups regarding patient demographics.

		Group [F] [No.=30]	Group [A] [No.=30]	t-test	P-value
Age[year]		27.367 $\pm$ 5.75	27.4 $\pm$ 7.37	0.49175	>0.05
Sex	Male	23 [76.67%]	27 [90%]	0.105657	>0.05
	Female	7 [23.33%]	3 [10%]		
Weight		79.87 $\pm$ 14.1	77 $\pm$ 12.93	0.1553	>0.05
ASA	ASA I	15 [50%]	16[53.33]	0.4065	>0.05
	ASA II	15 [50%]	14[46.67]		

**Table 2: Heart rate [b/m], and MAP [mmHg] changes between the two groups**

		G F Mean	G A Mean	t-test			G F Mean	G A Mean	t-test
Pre-operative		79.16	76.3	0.11	Pre-operative		82.733	82.267	0.4313
HR intra operative	skin incision	77.83	74.63	0.074	MAP intra operative	skin incision	86.767	86	0.383
	15 min	79.23	75.7	0.054		15 min	84.2	84.467	0.449
	30 min	76.03	74.57	0.18		30 min	83.83	84.067	0.46267
	60 min	74.9	74.5	0.377		60 min	85.367	84.567	0.3484
HR post-operative	2 h	79.2	76.13	0.0613	MAP post-operative	2 h	84.2	84.9	0.35997
	4 h	80.33	77.43	0.558		4 h	85.63	86.367	0.3695
	6 h	77	77.87	0.269		6 h	86.167	86.367	0.4635
	12 h	77.4	77.57	0.452		12 h	87.767	86.067	0.248
	24 h	77	75.9	0.203		24 h	87.167	85.43	0.23393

**Table 3: Numerical rating pain score [NRS] changes between the two groups**

		G F [Median]	G A [Median]	P-Value
NRS Post-operative	30 min	2	1	>0.05
	60 min	2	2	>0.05
	2 h	2	2	>0.05
	4 h	2	2	>0.05
	6 h	2	2	>0.05
	8 h	2	2	>0.05
	12 h	2	2	>0.05
	24 h	2	2	>0.05

## DISCUSSION

Pain is a stress response of the body damage and is not only a physiological response but also a psychological reaction. Severe pain can cause an experience of psychological burden, stress, a restless mood, and affect postoperative exercise and recovery. Lower limb surgery usually results in moderate-to-severe pain for the first 24–48 hours, mostly due to bony and soft tissue damage. Inadequate pain control affects the success of patients' rehabilitation programs, and postoperative pain is one indicator of discharge criteria [8].

For optimal patient flow in day-case surgery departments, patients must be mobilized early after surgery. An effective pain control is therefore a crucial intervention. Pain is an individual sensation, and the individual level of post-operative pain is difficult to be predicted, especially, if the level of surgical intervention differs from the initial plan [3].

Peripheral nerve blocks are associated with less pain and lower odds of unplanned hospital admission compared to systemic analgesia [4]. In addition to imaging the needle and nerve, ultrasound clearly reveals the surrounding hazardous structures, including blood vessels. Therefore, the risk of systemic toxicity due to fault intravascular injection and peripheral neuropathy due to mechanical trauma and/or accidental intraneuronal injection should be diminished with ultrasound guidance [6].

In our study, there was no significant difference between groups regarding patient's demographic data, hemodynamics before and after surgery till the end of follow up time. Mohamad *et al.* [9] reported that there was a non significant difference between the studied groups [adductor canal block and femoral nerve block] about changes in heart rate [HR] and mean arterial pressure [MAP]. These results are in line with the current work.

Results of the current work revealed that, both analgesic techniques are associated with a satisfactory and comparable results regarding pain control after surgery, till the end of follow up time at the end of the first postoperative day.

These results agree with Abu Elyazed *et al.* [10] who demonstrated that the visual analogue scale in adductor canal block vs fascia iliaca compartment block was statistically non-significant during the first postoperative 12 hours. However, they reported significantly higher VAS at 18 and 24 hours with adductor canal block.

As a result of comparable pain scores, the total opioid consumption in the postoperative first 24 hours showed a non-significant difference between groups. These results agree with Chisholm *et al.* [11] who reported that there were no significant differences between the femoral nerve block and saphenous block, as regard to narcotic consumption on postoperative day 1 and day 2. Narcotic consumption in the recovery room was also not significantly different between the two groups.

Regarding motor block in the current study, the adductor canal block showed no motor block, but the fascia iliaca block showed a block of motor function of quadriceps muscles in the same duration as a sensory block. Mohamad *et al.* [9] reported that, the duration of motor block and the functional mobility of an individual measured by [Berg Balance Score <40] in patients who received adductor canal block was zero. However, in patients received femoral nerve block, the duration of motor block ranged between 2-8 hours with a mean value [4.68±1.3] hrs.

On the other hand, Jaeger *et al.* [12] reported that the reduction of quadriceps strength from baseline was 49% with FNB but only 8% with ACB in healthy young subjects. This may be because, ACB is almost a pure sensory nerve block within an aponeurotic tunnel containing several sensory nerves and only a single efferent motor nerve, which has a minimal effect on quadriceps strength compared with FNB.

Our study demonstrated that the overall level of patient's satisfaction about the procedure and postoperative analgesia was comparable between both groups with no significant difference between the two groups.

In agreement with our results, a meta-analysis by Wang *et al.* [13] on 194 primary

TKAs [including 97 with ACB and 97 with FNB] were pooled from 3 trials, to analyze patient satisfaction. The results suggested that ACB was not inferior to FNB concerning the patient satisfaction at post-anesthesia 48 hours. Additionally, the difference between groups was not significant within 24 hours post-anesthesia and no heterogeneity was identified.

Limitations of the current study include the absence of the control group, the pain was assessed only during rest, and small number of patients.

**Conclusion:** ACB [10 ml bupivacaine 0.25%] and FIB [20 ml bupivacaine 0.25%] provided effective and satisfactory post-operative analgesia for patients undergoing knee arthroscopic surgery. ACB was associated with quadriceps muscle strength sparing and early ambulation compared to FIB.

#### Financial and Non-financial Relationships and Activities of Interest

None

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