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Retrospective evaluation of postoperative analgesia efficacy of a new technique in anterior iliac crest bone graft harvesting: anterior iliac block

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Abstract

Background In reconstructive surgeries, iliac crest bone graft harvesting is commonly preferred. The pain experienced after surgery at the anterior iliac crest (AIC) donor site might be more intense compared to the pain at the primary surgical area where the graft is placed. To address this issue, we defined a novel technique called the anterior iliac block (AIB), which can provide analgesia with lower volumes. In this study, the effect of this technique for AIC bone greft harvesting was evaluated.

Methods Patients who were operated on and had AIC bone graft harvested included in this retrospective study. The study collected age, height, weight, ASA classification, and duration of surgery, information on the regional anesthesia technique, block performance, postoperative pain severity, opioid consumption, rescue analgesics used in the first postoperative 24 h.

Results Data from 16 patients were analyzed. The popliteal sciatic block was performed in eight patients, infraclavicular brachial plexus block in four patients, supraclavicular brachial plexus block in one patient, PENG block in one patient, and proximal adductor canal block in two patients two provide analgesia for primary surgery. The median morphine consumption at postoperative 24th hour was 3.5 mg, median NRS score was 1 at postoperative 1st hour, and 0 at postoperative 6th, 12th and 24th hours.

Conclusions The study findings indicate that the AIB provides adequate analgesia for AIC graft harvesting in the first postoperative 24-hour period. It can be used as an adjuvant to the peripheric nerve block for the primary surgical site.

Trial registration NCT06295224.

Keywords Anterior iliac block, Iliac crest bone greft harvesting, Postoperative pain, Regional anesthesia, Ultrasound guidance

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Background

Iliac crest bone graft harvesting is commonly used for various reconstructive surgeries as a source of cortical and cancellous bone [1]. Anterior iliac crest (AIC) is frequently used as a donor site while the patient is in the supine position to provide better outcomes. It may lead to severe postoperative pain, which increases morbidity [2, 3]. In addition, pain at the donor site can be worse than the primary surgical area [4].

Local infiltration methods are being used; however, they can be performed after the harvesting by the surgical team, and the duration of analgesia is short [5]. Therefore, several regional anesthesia methods such as transversus abdominis plane (TAP) block, transversalis fascia plane block (TFPB), erector spinae plane (ESP) block or transmuscular quadratus lumborum block (QLB) have been described which target the spinal nerves (T12-L1) [4, 6–8]. However, these fascial plane blocks require high volumes to block the targeted nerves reliably. Considering the regional anesthesia technique for the primary surgical site (brachial plexus block, sciatic nerve block, etc.), an additional fascial plane block that is performed away from the graft area can be inadequate or can increase the local anesthetic systemic toxicity risk. Hence, to infiltrate local anesthetic with ultrasound guidance before the surgery [9]. In local anesthetic infiltration, the probe is placed on AIC, and the local anesthetic is administered with an 80 mm needle over the bone. As this simple technique appears laborless, the injection site is too superficial, and the tendons of several muscles attach to AIC, which makes the injection difficult. By moving the probe slightly medially and tilting caudally, it is possible to view the iliacus muscle where it attaches to AIC and the abdominal muscle layer above the iliacus muscle (Fig. 1). Between these muscles, there is a fascial layer, which can be considered as a midpoint of transition of fascia iliaca and fascia transversalis [10]. We hypothesized that reaching this fascia layer in the vicinity of the surgical site requires lower volumes with better analgesia, and we named this novel technique 'Anterior iliac block' (AIB).

In this study, our goal was to assess the impact of AIB on the harvest of anterior iliac crest bone grafts in orthopedic surgeries when used alongside regional anesthesia to provide pain relief for the main surgical site.

Methods

This retrospective study was approved by the institutional ethical committee (GOKAEK-2024/02.19), and the study was registered at ClinicilalTrials.gov (NCT06295224). Patients who were operated on and had AIC bone graft harvested by the Department of Orthopedics and Traumatology between January 2021 - December 2023 and AIB performed were included in this study. The regional anesthesia archive provided the pre- and perioperative data. Information on age, height, weight, American Society of Anesthesiologists (ASA) classification, and surgery duration was collected. Detailed data on regional anesthesia technique, block performance, postoperative pain severity, postoperative opioid consumption, use of rescue analgesics, and early postoperative complications (not less than the first 24 h after the surgery) is included.

Description of anterior iliac block technique and anesthetic care

As a standard protocol in our clinic, the block technique, a peripheral nerve block to provide analgesia for the primary surgical site, was performed in the block room before the operation to avoid possible complications such as nerve injury. However, the anterior iliac block (a fascial plane block) was performed following the general anesthesia induction.

All patients were brought to the block room before the operation. Following the standard monitorization (electrocardiogram, non-invasive blood pressure,

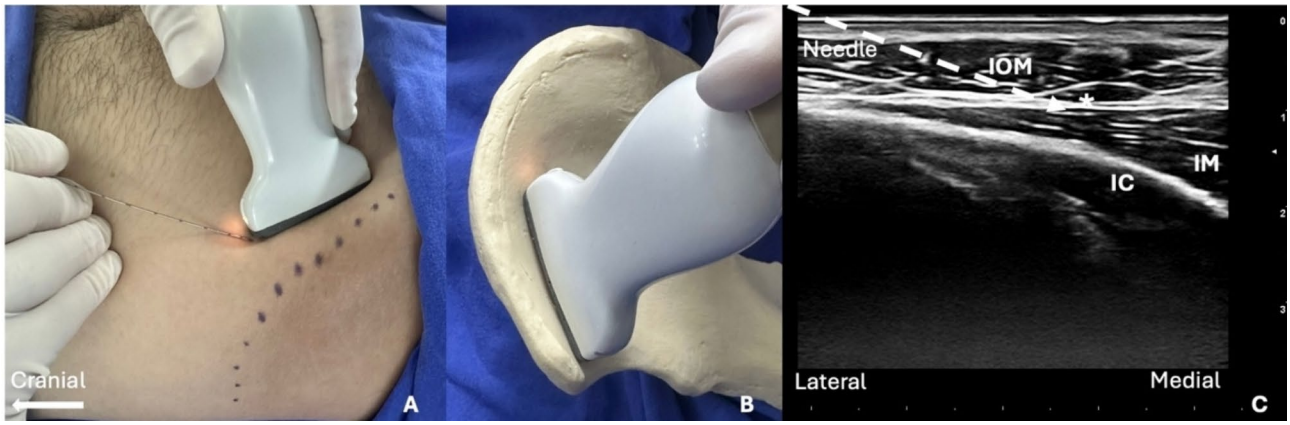

Fig. 1 Anterior iliac block. **A**: Probe and needle position. **B**: The demonstration of probe position on a model. **C**: Ultrasound image, IC: iliac crest, IM: iliacus muscle, IOM: internal oblique muscle, *: aponeurosis of transversus abdominis muscle

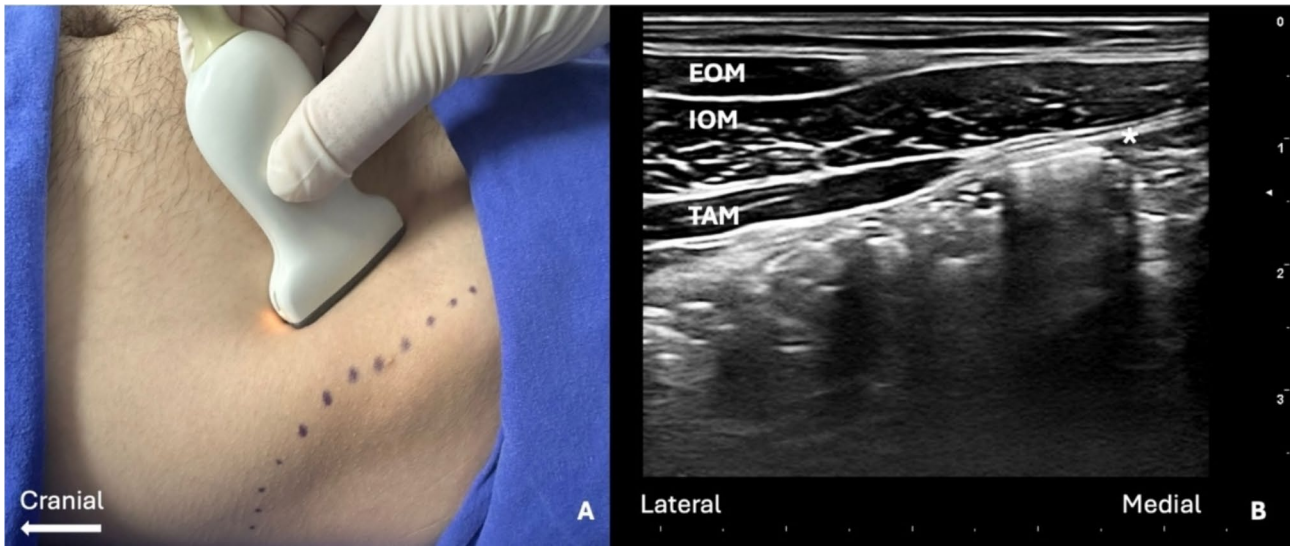

Fig. 2 **A**: The probe position and **B**: ultrasound image when probe is advanced more medially while performing AIB to identify the muscle and fascia layers. EOM: external oblique muscle, IOM: internal oblique muscle, TAM: transversus abdominis muscle, *: aponeurosis of transversus abdominis muscle

and pulse-oximetry) and intravenous (IV) access were obtained, patients received 2 mg midazolam IV prior to the regional anesthesia block. Brachial plexus block (infraclavicular or supraclavicular), popliteal sciatic nerve block, pericapsular nerve group (PENG) block, or proximal adductor canal block regarding the operation site was performed with 20 ml of 0.25% bupivacaine with ultrasound guidance.

In the operation theatre, general anesthesia was inducted with 2–3 mg/kg propofol, 1–2 mcg/kg fentanyl, and 0.6 mg/kg rocuronium. General anesthesia was maintained with sevoflurane in combination with 40% oxygen mixture in air and remifentanil infusion (the dose was adjusted according to the hemodynamic parameters).

After the induction, AIB was performed using a linear probe. The probe was placed on the anterior aspect of the anterior iliac crest (Fig. 1). Afterward, the probe was advanced medially and tilted cranially to visualize the iliacus muscle where it attaches to AIC. In the ultrasound image, the iliacus muscle, internal oblique muscle above, aponeurosis of transversus abdominis muscle between these muscles, and ilium were seen (Fig. 1). With advancing the probe further, layers of abdominal muscles visualized to identify the muscle and fascial layers correctly at the block site (Fig. 2). With an in-plane approach, an 80-mm block needle was advanced from lateral to medial, and 10 mL of 0.25 mL was injected in the plane between the iliacus and aponeurosis of transversus abdominis muscle after hydrodissection with saline.

Multimodal analgesia regimen was used with these patients. This consisted of tramadol 1 mg/kg and paracetamol 1 g IV were administered for postoperative analgesia at the end of surgery. Paracetamol was also administered every six hours. The patient-controlled analgesia device given to patients had 0.5 mg/ml morphine and was programmed to give a 1 mg bolus dose. It had an 8-minute lockout time and a 1-hour limit of 6 mg. If the Numeric Rating Scale (NRS) exceeded 3, patients received rescue analgesia in the form of a 20 mg IV dose of tenoxicam.

Table 1 Demographic data of the patients

ASA I/II/III	8/7/1
Age (years)	42.5 ± 14.44
Weight (kg)	77.75 ± 16.23
Height (cm)	169.75 ± 11.31
Operation time (min)	135.94 ± 64.45

Values are presented as numbers or mean ± SD

Statistical analysis

Statistical analyses were performed using IBM SPSS for Windows version 20.0 (SPSS, Chicago, IL, USA). To evaluate the assumption of normality, the Shapiro-Wilk test was employed. Mean ± standard deviation or median (25th-75th percentile) values were used to present numerical variables, based on the normality of the data.

Results

Data for 16 patients who received AIB was included in this study. Eight patients were male, and eight patients were female. The American Society of Anesthesiology (ASA) physical status scores were '1' for eight patients, '2' for seven, and '3' for one. The mean age was 42.5 ± 14.44, the mean weight was 77.75 ± 16.23 kg, and the mean height was 169.75 ± 11.31 cm. The mean operation time was 135.94 ± 64.45 min (Table 1). Eight patients received popliteal sciatic block (for talus osteochondritis dissecans surgery), four patients received infraclavicular brachial

plexus block (for scaphoid fracture), one patient received supraclavicular brachial plexus block (for humerus fracture), one patient received PENG block (for osteosarcoma of proximal femur), and two patients received proximal adductor canal block (for osteochondroma of the medial malleolus). Morphine consumption amounts and NRS scores were shown in the Table 2, and mean morphine consumption at postoperative 24th h was 6.75±9.36 mg. Two patients received tenoxicam as a rescue analgesic. No complications were observed.

Discussion

This study shows that AIB provides adequate analgesia for anterior iliac crest bone graft harvesting in the first postoperative 24-hour period. AIB requires lower volumes and is performed in the vicinity of the graft area, which may increase the success rates of this fascial plane block. It can be used as an adjuvant to the peripheric nerve block for the primary surgical site.

Some patients had mild postoperative pain, and the amount of opioid consumption was higher. The reason could be due to the complex innervation of the lower extremity, especially of the hip and the knee joints [11, 12]. As regional techniques provide adequate analgesia for the operations of the thigh, it is not comparable with a brachial plexus block for the upper extremity or a sciatic nerve block for the ankle.

There was no control group in this study to compare the opioid consumption amount. However, in a study of Black et al., median opioid consumption in morphine equivalant was 13 mg at postoperative 8th hour in patients who received sham block [4]. In this study, patients also received patient-controlled analgesia device containing an opioid, similar with our study. In our study, median morphine consumption was 3.5 mg at postoperative 24th hour, therefore this study shows that AIB may provide effective analgesia and reduces the opioid consumption.

Mainly subcostal, ilioinguinal, and iliohypogastric nerves innervate the periost of AIC and the subcutaneous tissue above with the skin [13, 14]. To block these nerves, TAP block have been used to provide analgesia for AIC bone graft harvesting [7, 15]. Sondekoppam et al. [6] used transmuscular QLB for analgesia to cover L2-3 dermatomes, as lateral femoral cutaneous nerve may also innervate the tissues above the AIC. Chin et al. [16] and Black et al. [4] described the use of TFPB to cover the L1 dermatome because the TAP block may not always cover. However, the efficacy of these blocks is volume dependent and may cause motor weakness due to spread to the femoral nerve or lumbar plexus [17, 18].

Table 2 Morphine consumptions and NRS scores at 1, 6, 12, and 24 h postoperatively

	Morphine consumption (mg)	NRS Score
1st h	1.0 (1.0, 1.0)	1.0 (0.0, 2.0)
6th h	2.0 (1.0, 3.0)	0.0 (0.0, 1.75)
12th h	2.5 (1.0, 7.0)	0.0 (0.0, 1.0)
24th h	3.5 (1.0, 7.5)	0.0 (0.0, 1.0)

Values are presented as median (Q1, Q3)

The injection point for the AIB is the fascial plane between the iliac muscle and aponeurosis of transversus abominis muscle immediately medial to AIC. Fascia iliaca attaches to the superolateral sides of the iliac crest, close to the injection point. The lateral femoral cutaneous nerve crosses the iliac muscle posterior to the fascia iliaca at this area [19]. In addition, ilioinguinal and iliohypogastric nerves lie very close to AIC [20]. When the ilioinguinal-iliohypogastric block technique is considered, the ultrasound probe is placed perpendicular to AIC, the same area with a different view (Fig. 3). The traverse of the nerves varies and can be found inside the transversus abdominis plane or between the external and internal oblique muscles [21]. However, blocking these nerves with AIB with a small volume is highly possible.

Local anesthetic may also cover the small cutaneous branches. Fascia iliaca is the continuation of the transversalis fascia, and AIB may have a mechanism similar to TFPB [22]. In addition, the injection point is in the vicinity of the iliac bone, the donor site. Therefore, it is possible to block the small sensory nerves that join the innervation of the ilium.

There are several limitations of this study. This is a retrospective study with a limited number of patients. However, it is important to note that the data shared in this manuscript is the experience of a two-year performance of the block in our clinic, which means that along with the patients, both the surgeons and anesthesia team were satisfied with the analgesia provided. Although having no control group could be another limitation, comparing our results with the current literature might be adequate to show the benefits of this new technique. It can be easily found in the current literature patients frequently report experiencing more pain from the iliac harvest than from the main surgical site during postoperative recovery [3]. In addition, it can be seen that the average opioid use after this type of surgery is much higher than our results [16]. Another possible limitation is that different surgery types were included. Our patients have undergone different orthopedic surgeries, and the graft size used varied accordingly. However, a study conducted by Schaan et al. [23] found no correlation between the size of the harvested graft and the patients' pains. Despite its limitations, this study fulfilled its goals by providing useful information on this new technique.

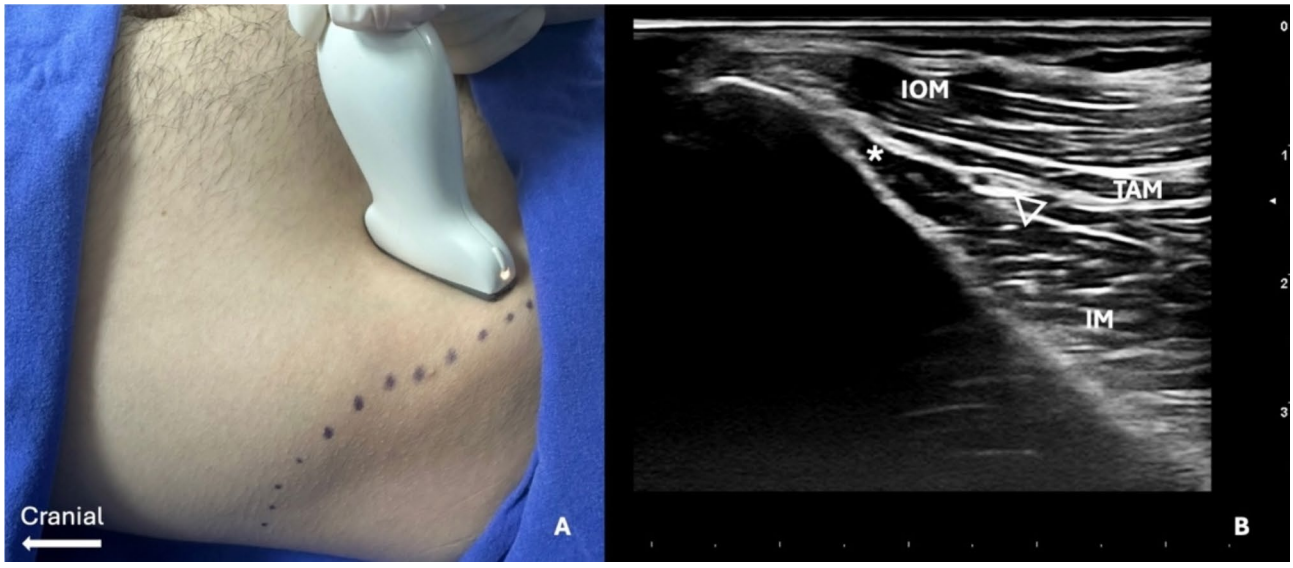

Fig. 3 **A**: Probe position and **B**: ultrasound image of ilioinguinal-iliohypogastric nerve block technique. IOM: internal oblique muscle, TAM: transversus abdominis muscle, IM: iliacus muscle, *: ilioinguinal nerve, ◁: deep circumflex iliac artery and iliohypogastric nerve

Conclusions

In conclusion, based on the results of this descriptive retrospective study, preoperative ultrasound-guided Anterior Iliac Block could be a promising technique for providing postoperative analgesia after AIC bone graft. The block is performed with the help of ultrasound guidance, which increases the accuracy of needle placement and local anesthetic distribution. The procedure is safe, with no significant adverse effects reported in the study participants. However, while the findings of the study are promising, further comparative studies are required to confirm its effectiveness and explore its impact on long-term and chronic pain complications. These studies will help establish the technique's place in pain management protocols for orthopedic surgery patients.

Abbreviations

AIB	Anterior iliac block
AIC	Anterior iliac crest
ASA	American Society of Anesthesiologists
ESP	Erector spinae plane
IV	Intravenous
NRS	Numeric rating scale
PENG	Pericapsular nerve group
QLB	Quadratus lumborum block
TAP	Transversus abdominis plane
TFPB	Transversalis fascia plane block

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [HUY, İlA, AG, ÖS]. The draft of the manuscript was written by [HUY, CA, SC, AK]. All authors read and approved the final manuscript.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

All protocol were carried out in accordance with relevant guidelines and regulations, and had been approved by Ethic Committee prior of the study. The patients are verbally informed about the data acquisition protocol and written informed consent was obtained from all patients and/or their legal guardian(s). No violation of Helsinki Declaration was taken place during informed consent and data acquisition period. The study protocol had been approved by Ethic Committee of Kocaeli University Medical Faculty (GOKAEK-2024/02.19) and This studywas registered with clinicaltrials.gov (NCT06295224).

Competing interests

Can AKSU and Hadi Ufuk YÖRÜKOĞLU are members of the Editorial Board of BMC Anesthesiology.

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