Efficacy of transversalis fascia plane block for postoperative analgesia in lliac crest bone grafting - A triple blind, prospective randomised study

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KEYWORDS

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ABSTRACT

Background: Iliac crest bone grafting (ICBG) can cause intense postoperative pain, often exceeding that of the primary surgical site, leading to suboptimal outcomes and prolonged recovery.**Objective:** To determine whether a transversalis fascia plane (TFP) block enhances postoperative analgesia and reduces opioid use compared with placebo after anterior ICBG for upper limb surgery in a triple-blind trial.**Methods:** Conducted this triple-blind, randomised study at Indira Gandhi Institute of Medical Sciences, Patna, Bihar (4th September 2020–31st October 2022). Sixty adults undergoing upper limb surgery requiring anterior iliac crest bone graft were assigned to either an ultrasound-guided TFP block (0.5% bupivacaine–epinephrine) or 5% dextrose placebo, with standard general anaesthesia and postoperative analgesia. Rescue morphine consumption was recorded.**Results:** In total, 60 patients (30 per group) completed the trial. Postoperative morphine use at 24 hours was significantly lower in the TFP block group (12.3 ± 2.2 mg) compared with controls (27.1 ± 5.0 mg; $p<0.001$), indicating a 54.5% reduction. Mean time to first analgesia was prolonged in the TFP group by 4.9 hours (6.2 ± 1.1 vs 1.3 ± 0.4 hours; $p<0.001$). Intraoperative fentanyl supplementation was required by 10% of TFP recipients versus 100% of controls ($p<0.0001$). No major adverse events or opioid-related side effects were observed. Overall, TFP patients reported lower 24-hour VAS scores and significantly improved satisfaction compared with those receiving placebo.**Conclusion:** TFP block is a safe, effective strategy for reducing donor-site pain and opioid requirements following anterior ICBG. Its targeted approach can enhance patient comfort and potentially improve long-term clinical outcomes.

INTRODUCTION

The surgical harvesting of autologous bone graft from the anterior iliac crest remains one of the most frequently employed methods for reconstructive procedures in orthopaedic, spinal, and maxillofacial surgeries due to the osteogenic potential and biocompatibility of native bone tissue, yet it is also associated with significant postoperative pain and morbidity at the donor site, sometimes exceeding pain at the primary surgical site [1]. Historically, the anterior iliac crest bone graft (ICBG) harvest site has been linked to a range of complications including chronic neuropathic pain, infection, hematoma, nerve injury, and prolonged hospital stays. Such acute postoperative donor-site pain carries the potential to evolve into chronic pain syndromes, thus adversely affecting patient satisfaction and functional recovery. This makes it paramount to identify robust strategies for minimizing morbidity and facilitating a comfortable postoperative course. Traditional approaches, including local anaesthetic infiltration (single-shot or continuous infusion) or neuraxial techniques, offer varying degrees of efficacy but also present challenges such as inconsistent sensory coverage, risk of infection at the infiltration site, or risk of neuraxial complications. Against this backdrop, the development and

refinement of fascial plane blocks have transformed the landscape of regional anaesthesia. Specifically, the transversalis fascia plane (TFP) block has emerged as a potentially superior alternative, given its ability to target the iliohypogastric and ilioinguinal nerves, which predominantly supply the anterolateral abdominal wall and the anterior crest region [2].Iliac crest innervation primarily involves the T12 and L1 spinal nerves, with contributions from the subcostal and iliohypogastric nerves, whose anterior and lateral cutaneous branches innervate the skin and deeper tissues overlying the bony crest. Conventional transversus abdominis plane (TAP) blocks may not reliably capture these higher thoracolumbar nerve branches because the nerves often branch out more proximally, near or even above the transversus abdominis layer. By contrast, the TFP block—performed by depositing local anaesthetic between the transversus abdominis muscle and the transversalis fascia—provides a more targeted blockade of these nerves. Early descriptive studies noted that TFP block can consistently provide analgesia to T12 and L1 dermatomes, which are of cardinal importance for ICBG site coverage. This technique was first described in a cadaveric context, and subsequent case reports and small-scale studies corroborated its utility in specific surgeries requiring analgesia of the lower abdominal region [3].The rationale for exploring TFP block in the setting of iliac crest bone graft harvesting is further driven by concerns over opioid-related adverse effects, including respiratory depression, sedation, nausea, vomiting, and the risk of long-term dependency. In many elective orthopaedic and reconstructive procedures, clinicians aim to adopt multimodal analgesic regimens that mitigate these opioid-related complications. The overarching hypothesis of the present study is that a TFP block, administered under ultrasound guidance, would significantly reduce total perioperative opioid requirements and improve patient comfort compared to a placebo or standard analgesic protocol. Although transversus abdominis plane blocks have garnered recognition for improving analgesia in various abdominal procedures, precise and consistent blockade of the T12 and L1 dermatomes has not always been reproducible, making TFP block an anatomically rational and potentially more robust alternative [4].Early evidence, such as the retrospective similar study showed that patients receiving TFP blocks had lower requirements for intravenous morphine equivalents after ICBG procedures. In a subsequent randomised controlled trial by Abdelbaser*et al*., the TFP block group demonstrated significantly reduced postoperative opioid use during the immediate postoperative period compared with a placebo group, although their study faced methodological limitations, including smaller sample size and concomitant use of spinal anaesthesia in a subset of patients [5]. These foundational studies thus underscore both the promise and the need for further robust, large-scale, and methodologically sound trials that exclusively examine TFP block efficacy without confounding factors such as neuraxial anaesthesia.

Furthermore, postoperative pain at the ICBG site is often cited as one of the foremost reasons patients express reluctance or dissatisfaction regarding autologous graft procedures [6]. Studies have reported that patients occasionally rate their ICBG donor site pain as more bothersome than the pain at the primary operative site, highlighting the imperative of refining analgesic strategies. Beyond acute pain, inadequate analgesia in the early postoperative phase has been linked to the development of persistent postsurgical pain syndromes that degrade patients' long-term quality of life. By effectively blocking the sensory input from T12 and L1 nerves, the TFP block may interrupt central sensitization mechanisms that foster the transition from acute to chronic pain, potentially altering the trajectory of pain-related morbidity.It is also critical to highlight that the TFP block technique, when performed with the guidance of high- or low-frequency ultrasound transducers, carries a relatively favorable risk profile, with complications such as local anaesthetic systemic toxicity, vascular puncture, or inadvertent bowel or peritoneal injury being exceedingly rare if strict adherence to ultrasound visualization and standard safety checks are maintained [7]. Reports indicate that block performance time, overall feasibility, and patient acceptance are high when an experienced anaesthesiologist or trained resident performs the procedure. Additionally, the TFP block spares motor innervation to the lower limbs, unlike certain lumbar plexus blocks, thus facilitating early mobilization and postoperative physiotherapy—components often vital for optimal recovery after orthopaedic or reconstructive surgeries.In the context of the present triple-blind, prospective randomised trial, patients undergoing upper limb reconstructive surgery that requires autologous ICBG harvesting are allocated to receive

either a TFP block with local anaesthetic or a placebo injection. Outcomes of interest include total postoperative morphine consumption over 24 hours, intraoperative fentanyl requirements, patient-reported pain scores on standardized instruments such as the Visual Analogue Scale (VAS), and the time to first postoperative rescue analgesia. These parameters collectively provide a comprehensive view of analgesic efficacy and pave the way for formulating standardized protocols. The study design also implements robust blinding—where the patient, the block performer, and the data collectors are all masked to the group allocations—to ensure the highest level of methodological integrity. This approach addresses gaps in the existing body of literature, particularly concerning the reproducibility and consistency of TFP block results. Consequently, the knowledge gained from this investigation will contribute to refining best practices for postoperative analgesia in patients undergoing ICBG harvesting, reducing the burden of both acute and chronic pain. It will also provide a critical step toward incorporating TFP blocks into routine perioperative care, advancing the paradigm of multimodal analgesia while addressing a pervasive source of discomfort that has historically challenged surgeons and anaesthesiologists alike.

Aims and Objective

To assess the analgesic efficacy of the transversalis fascia plane (TFP) block following iliac crest bone graft harvesting. The objectives included comparing total postoperative opioid consumption, time to first rescue analgesia, and pain intensity scores between TFP block and placebo, providing definitive data for optimized pain management.

MATERIAL AND METHODS

Study Design

This triple-blind, prospective, randomized study was conducted at Indira Gandhi Institute of Medical Sciences, Patna, Bihar, from 4th September 2020 to 31st October 2022. Participants were screened based on predefined eligibility criteria and assigned to receive either an ultrasound-guided transversalis fascia plane (TFP) block with 0.5% bupivacaine-epinephrine (1:200,000) or a placebo injection (5% dextrose). Allocation was accomplished using a computer-generated random table, and group assignments were concealed in opaque envelopes. Only an independent research assistant, responsible for preparing the study drugs, had access to allocation. The clinical team, patients, and outcome assessors remained blinded throughout the trial. Primary endpoints included postoperative morphine consumption, time to first rescue analgesia, and VAS pain scores. Secondary measures encompassed intraoperative fentanyl requirements and overall patient satisfaction. The standardized general anesthetic protocol was maintained for all participants to minimize confounding factors, ensuring valid comparisons between the active intervention and the placebo group.

Inclusion Criteria

Eligible participants were adults aged 18–80 years with American Society of Anesthesiologists (ASA) physical status I–III, scheduled for upper limb surgical procedures requiring anterior iliac crest bone graft harvesting. All subjects had a body weight above 50 kg and the ability to understand the study protocol and provide written informed consent. They were required to have a normal coagulation profile and no preexisting chronic pain disorders or prior surgery affecting the abdomen or pelvic region.

Exclusion Criteria

Patients with known allergies to local anaesthetics, severe hepatic or renal dysfunction, coagulopathy, or infection at the injection site were excluded. Pregnant or lactating women, individuals with opioid dependence, uncontrolled psychiatric illness, or chronic pain syndromes requiring long-term analgesics were omitted. Those who refused consent or were unable to comprehend study instructions, and patients with anatomical abnormalities preventing ultrasound visualization of the transversalis fascia plane, did not participate. Any significant abdominal wall pathology was excluded.

Data Collection

All demographic information, including age, sex, body mass index, and ASA status, was recorded preoperatively. Baseline pain scores were obtained, along with vital signs and any relevant comorbidities. The assigned block or placebo intervention was administered before surgery. Intraoperative data—such as heart rate, blood pressure, and total fentanyl administered—were documented. Postoperatively, morphine consumption, time to first rescue analgesia, and pain intensity (VAS scores) at specified intervals up to 24 hours were captured. Any adverse events or complications related to the block procedure were noted. The study coordinator ensured timely completion of all assessments and maintenance of confidentiality. All data were securely stored.

Data Analysis

All statistical analyses were conducted using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Normality checks included the Shapiro-Wilk test, guiding the choice of parametric or nonparametric tests. Descriptive statistics were reported as mean ± standard deviation or median (interquartile range), depending on distribution. Between-group comparisons of continuous variables were performed using the independent t-test or Mann-Whitney U test, while categorical variables were compared via chi-square or Fisher's exact tests. A p-value <0.05 indicated statistical significance. Subgroup analyses examined potential influences of age, sex, or comorbidities on analgesic outcomes. Confidence intervals were calculated. All data were analyzed on an intention-to-treat basis.

Ethical Considerations

The trial was registered with the Clinical Trials Registry–India (CTRI/2020/20/023285 dated 13/02/2020), and ethical approval was obtained from the Institutional Ethics Committee prior to participant enrollment. Informed consent was secured from all patients, using their preferred language to ensure clear understanding. Each participant was made aware of their voluntary status and their absolute right to withdraw from the study at any time without repercussion. Confidentiality measures included assigning coded identifiers, with only designated research personnel granted access to protected data. The entire study was conducted in strict compliance with the principles laid out in the Declaration of Helsinki, as well as with all pertinent national regulations.

RESULTS

A total of 60 patients (30 in the Transversalis Fascia Plane [TFP] group and 30 in the Control group) completed the study. No patients were lost to follow-up. The mean age of the overall cohort was 35.1 ± 9.2 years, and the majority of participants were classified as American Society of Anesthesiologists (ASA) I or II. Detailed comparisons between the two groups are presented in six tables below, each followed by a concise summary. All proportions and percentages are calculated against the total of 60 patients, representing 100% of the study population.

Table 1. Demographic Characteristics

Variable	TFP Group (n=30)	Control Group (n=30)	Total (N=60)	p-value
Age (years) Mean ± SD	35.4 ± 9.6	34.8 ± 8.9	35.1 ± 9.2	0.72 (NS)
Age Range (years)	20–52	19–53	19–53	–
Sex [M/F] (n, %)	18 (60%) / 12 (40%)	17 (56.7%) / 13 (43.3%)	35 (58.3%) / 25 (41.7%)	0.80 (NS)
BMI (kg/m²) Mean ± SD	26.2 ± 3.8	26.5 ± 4.1	26.4 ± 3.9	0.71 (NS)
ASA Classification I / II / III (n, %)	16 (53.3%) / 14 (46.7%) / 0 (0%)	15 (50%) / 13 (43.3%) / 2 (6.7%)	31 (51.7%) / 27 (45%) / 2 (3.3%)	0.31 (NS)

Groups were comparable in age, sex distribution, body mass index (BMI), and ASA status. No statistically significant differences were observed ($p > 0.05$), indicating successful randomisation without major demographic imbalances.

Table 2. Operative Details

Variable	TFP Group (n=30)	Control Group (n=30)	p-value
Duration of Surgery (min) Mean ± SD	112.4 ± 18.5	115.2 ± 16.9	0.43 (NS)
Type of Upper Limb Procedure (n, %)	Ulnar Reconstruction: 10 (33.3%) Humerus Fixation: 20 (66.7%)	Ulnar Reconstruction: 12 (40%) Humerus Fixation: 18 (60%)	0.60 (NS)
Volume of LA for Brachial Plexus Block (mL) Mean ± SD	34.2 ± 2.5	34.6 ± 2.2	0.52 (NS)
Harvest Site Right / Left ICBG (n, %)	17 (56.7%) / 13 (43.3%)	15 (50%) / 15 (50%)	0.61 (NS)

Operative characteristics, including duration of surgery, type of upper limb procedure, volume of local anaesthetic (LA) for the brachial plexus block, and laterality of bone graft harvest, did not differ significantly between groups.

Table 3. Intraoperative Analgesic Consumption

Variable	TFP Group (n=30)	Control Group (n=30)	p-value
Intraoperative Fentanyl Use (n, %)	3 (10%)	30 (100%)	<0.0001 (S)
Total Fentanyl Dose (µg) Mean ± SD	18.3 ± 6.1	195.5 ± 11.4	<0.0001 (S)
Additional Inhalational Agent (%)	1.5 ± 0.2	1.5 ± 0.3	0.85 (NS)

The TFP group required significantly less intraoperative fentanyl, with only 10% of patients needing supplemental doses compared to all patients in the Control group ($p < 0.0001$). This suggests superior intraoperative analgesic coverage in the TFP block group.

Table 4. Postoperative Analgesic Consumption

Variable	TFP Group (n=30)	Control Group (n=30)	p-value
Total Morphine in 24h (mg) Mean ± SD	12.3 ± 2.2	27.1 ± 5.0	<0.0001 (S)
Time to First Rescue Analgesia (h) Mean ± SD	6.2 ± 1.1	1.3 ± 0.4	<0.0001 (S)
Paracetamol Use (n, %) (1 g q6h)	30 (100%)	30 (100%)	– (protocol)
Antiemetic Requirement (n, %)	5 (16.7%)	15 (50%)	0.01 (S)

Patients in the TFP group showed significantly reduced morphine usage over 24 hours ($p<0.0001$) and a longer interval before requiring rescue analgesia ($p<0.0001$). Fewer patients in the TFP group needed antiemetics ($p=0.01$), correlating with lower opioid consumption.

Table 5. Postoperative Pain Scores (VAS)

Time Point	TFP Group (n=30) Mean ± SD	Control Group (n=30) Mean ± SD	p-value
2 hours	1.7 ± 0.5	3.9 ± 0.6	<0.0001 (S)
6 hours	2.1 ± 0.7	5.1 ± 1.0	<0.0001 (S)
12 hours	2.8 ± 0.8	5.8 ± 1.3	<0.0001 (S)
18 hours	3.2 ± 0.9	5.0 ± 1.2	<0.0001 (S)
24 hours	2.6 ± 0.6	4.6 ± 1.1	<0.0001 (S)

Throughout the 24-hour assessment, the TFP group consistently reported lower VAS scores at all time points compared to the Control group ($p<0.0001$). These findings align with decreased opioid requirements and prolonged pain relief in the TFP group.

Table 6. Adverse Events and Complications

Adverse Event	TFP Group (n=30)	Control Group (n=30)	p-value
Local Anaesthetic Toxicity (n, %)	0 (0%)	0 (0%)	– (NA)
Block-Related Hematoma (n, %)	1 (3.3%)	0 (0%)	0.31 (NS)
Infection at Donor Site (n, %)	0 (0%)	2 (6.7%)	0.15 (NS)
Chronic Pain at 3 Months (n, %)	1 (3.3%)	5 (16.7%)	0.09 (NS)
Other Complications (n, %)	2 (6.7%)	3 (10%)	0.65 (NS)

Overall complication rates were low, with no cases of local anaesthetic systemic toxicity. Although the Control group showed a higher proportion of donor site infection and chronic pain at three months, these differences were not statistically significant ($p>0.05$). The single hematoma in the TFP group resolved spontaneously.In this triple-blind, prospective study, the TFP block significantly reduced both intraoperative and postoperative opioid requirements. Patients who received the TFP block had lower VAS scores, a delayed need for rescue analgesia, and fewer side effects, suggesting that TFP block provides superior analgesia compared to placebo for iliac crest bone graft harvesting. The low incidence of adverse events further supports the safety and feasibility of this regional technique in clinical practice.

DISCUSSION

Our study's findings demonstrate that the TFP block group experienced significantly less intraoperative fentanyl consumption, fewer patients requiring supplemental doses (10% in TFP group vs. 100% in controls), and a substantially reduced total fentanyl dose (mean 18.3 ± 6.1 µg vs. 195.5 ± 11.4 µg, $p<0.0001$). This drastic difference indicates that the TFP block can not only diminish the immediate need for strong analgesics but also maintain intraoperative haemodynamic stability, presumably through reliable sensory blockade of the T12–L1 dermatomes innervating the ICBG region. Postoperatively, patients receiving the TFP block had significantly reduced morphine usage within the first 24 hours (12.3 ± 2.2 mg vs. 27.1 ± 5.0 mg), illustrating a nearly 55% reduction. Concurrently, the TFP group's time to first rescue analgesia was extended (6.2 ± 1.1 hours vs. 1.3 ± 0.4 hours), corroborating superior analgesic coverage beyond the operative period. of particular interest is the discrepancy in antiemetic requirements: 16.7% in the TFP group vs. 50% in controls. This finding aligns with the literature suggesting that reduced opioid use translates to fewer side effects such as nausea and vomiting [8,9]. Furthermore, VAS pain scores at every measured time point (2, 6, 12, 18, and 24 hours) indicated significantly better pain relief in the TFP group ($p<0.0001$). The largest difference in VAS was noted during the earlier postoperative intervals (e.g., 2 and 6 hours), when acute pain typically peaks. These results affirm that the TFP block, as administered in our protocol, provides

robust and sustained analgesia, mitigating the need for additional opioid boluses,promotingpatient comfort, and possibly decreasing opioid-related side effects. Demographic characteristics were comparable between the groups—there were no statistically significant differences in age, sex, BMI, or ASA classification—implying that our randomisation effectively balanced covariates. Similarly, operative factors such as surgery duration, type of upper limb procedure, and the volume of LA used for the brachial plexus block did not differ significantly. This homogeneity further supports the contention that the observed differences in analgesic outcomes stem from the TFP block rather than from underlying confounders. Summarily, the TFP block proved to be a reliable, safe, and effective technique for achieving high-quality analgesia at the ICBG site.

Comparison with Existing Literature on TFP Block

Our findings are largely congruent with prior studies investigating TFP block analgesia for iliac crest bone grafting. Pak *et al*., in a retrospective series, found that patients receiving a TFP block had a mean total morphine-equivalent consumption of 18.5 ± 9.6 mg compared with 32.6 ± 12.4 mg in non-block patients—a reduction similar in magnitude to our results [10]. Additionally, those authors noted a significant difference in the requirement for intraoperative opioids, which mirrors the dramatic contrast we observed. Celik*et al*. reported similar trends in reduced opioid use during the early postoperative hours, although their study's primary outcome at 24 hours did not reach statistical significance, potentially due to a smaller sample size and the confounding effect of spinal anaesthesia in some patients [11]. By contrast, our study harnessed a homogenous population receiving general anaesthesia plus brachial plexus block (for the upper limb) in both groups, offering clearer insight into the isolated effect of TFP block at the ICBG site.

In several prospective studies examining the role of TFP blocks in abdominal surgeries, authors have also underscored the advantage of consistent blockade of T12 and L1 dermatomes, a limitation sometimes encountered with TAP blocks. Although TAP blocks typically provide good coverage from T7–T11, they may not reliably affect T12 or the ilioinguinal and iliohypogastric nerves, leaving the iliac crest donor region partially unanaesthetised. Our results reinforce this premise, demonstrating robust analgesic outcomes likely attributable to effective blockade of the relevant terminal branches that innervate the iliac crest. Additionally, while the posterior and subcostal TAP approaches have been proposed to extend the coverage somewhat, the TFP block appears better suited for reliably anaesthetizing T12–L1 branches.The consistency of our findings with earlier RCTs and observational reports supports the conclusion that TFP block, when administered correctly, provides high-value analgesia at the donor site. Moreover, the present study—featuring a randomised, triple-blind, placebo-controlled design—represents a robust methodological standard, diminishing the risk of bias. Thus, our trial constitutes an important addition to the body of evidence, confirming that TFP block is not only feasible but reproducibly effective for patients undergoing anterior ICBG.

Intraoperative Analgesia, Perioperative Opioid Consumption, and Haemodynamic Stability

One of the most compelling findings pertains to intraoperative fentanyl consumption. While earlier research into fascia plane blocks such as TAP generally focused on postoperative measures, our study underscores that a well-executed TFP block can also reduce intraoperative analgesic requirements. The 10% vs. 100% figures for supplemental fentanyl usage between the TFP and Control groups, respectively, are especially striking. This difference suggests that, in addition to blocking cutaneous and subcutaneous branches, the TFP block exerts sufficient analgesic effect on the periosteum and fascial layers that are manipulated during crest bone harvesting. The resultant advantage is not only a reduction in total intraoperative opioid requirement, but potentially smoother anaesthesia management, fewer haemodynamic fluctuations, and decreased anaesthesia-related morbidity [12]. Moreover, reduced perioperative opioids correlate with fewer occurrences of intraoperative or immediate postoperative sedation, respiratory depression, or potential difficulties in extubation and airway control. This advantage can translate to earlier patient mobilisation, shorter recovery room stays, and potentially greater patient satisfaction. Although we did not specifically measure haemodynamic

variables as primary outcomes, anecdotal clinical observations from anaesthesiologists involved in the study suggested fewer hypertensive or tachycardic episodes in the TFP group. This observation fits logically with a well-established principle: if adequate analgesia is provided in the zone of surgical insult, patients experience a more stable autonomic response [13]. Future studies might systematically quantify these haemodynamic parameters to further elucidate TFP's intraoperative benefits. Equally relevant is the potential cost-saving factor. Decreasing the requirement for potent opioid analgesics intraoperatively, hospitals could theoretically reduce pharmacy expenditures, and the lower incidence of side effects may cut down on ancillary treatments (e.g., antiemetics, sedation reversal agents). Although our study did not attempt a formal cost analysis, the positive correlation between regional analgesia and cost-effectiveness has been suggested in multiple surgical specialties. Hence, the TFP block can be viewed not only as a clinical advantage but also as a practice that might optimise resource utilisation—provided that institutional resources for ultrasound-guided blocks are readily available.

Postoperative Pain Scores, Functional Recovery, and Patient Satisfaction

Our analysis of postoperative VAS scores across multiple time points revealed significant differences in favour of the TFP group. Specifically, the TFP block consistently maintained VAS scores approximately 2–3 points lower than the Control group in the first 12 hours, with a persisting advantage at 24 hours. This prolonged effect could be due to various factors, including the pharmacodynamics of bupivacaine-epinephrine (which extends the duration of LA effect) and the potential "protective pre-emptive analgesia" conferred by effective nerve blockade before and during surgical stimulation [14]. Blocking nociceptive signals early, TFP may prevent central sensitization and hyperalgesia, which are implicated in persistent postoperative pain. Another essential factor is how postoperative pain impacts patients' functional outcomes, especially in orthopaedic or reconstructive surgeries requiring rehabilitation. Excessive pain at the donor site can lead to reluctance to ambulate or engage in physiotherapy, thereby delaying recovery of the primary surgical area. Although our study did not quantitatively assess functional metrics (e.g., time to ambulation), anecdotal clinical notes suggested that TFP patients exhibited more willingness to reposition and perform deep breathing exercises in the immediate postoperative period. This observation is consistent with studies showing that well-controlled pain correlates strongly with better compliance in postoperative physiotherapy regimens [15]. Improved analgesia also yields better patient satisfaction scores. While we did not formally administer a validated tool such as the Short-Form McGill Pain Questionnaire or the Brief Pain Inventory, we did note high rates of subjective patient satisfaction in the TFP group, as gleaned from routine postoperative nursing notes and phone follow-ups. The psychological impact of severe pain at the donor site is well-documented. Hence, lowering donor site pain does not merely mitigate an immediate physical burden; it can also reduce anxiety, postoperative depression, and overall dissatisfaction with surgical outcomes [16]. By extension, the TFP block emerges as a critical component of comprehensive perioperative care, aligning with the enhanced recovery after surgery (ERAS) protocols that emphasize multi-modal, opioid-sparing strategies.

Complications, Side Effects, and Safety Profile

A crucial dimension of adopting any regional block technique is the safety profile. In our series, none of the patients in either group experienced local anaesthetic systemic toxicity (LAST). The TFP block, by virtue of its ultrasound-guided nature and relatively superficial injection plane (compared to deeper plexus blocks), poses a lower risk of vascular puncture or inadvertent intraperitoneal injection when performed correctly [17]. We did observe one minor hematoma in the TFP group (3.3%), which resolved spontaneously, and two cases of infection at the donor site in the Control group (6.7%), although the latter difference was not statistically significant. Chronic pain at three months was somewhat higher in the Control group (16.7% vs. 3.3% in TFP), aligning with the theory that inadequate early analgesiacan predispose patients to persistent postsurgical pain [18]. Notably, the incidence of postoperative nausea and vomiting (PONV) was significantly lower in the TFP group, most likely due to reduced reliance on opioid analgesics. This association is well-corroborated in the literature. The clear advantage of fewer antiemetic requirements highlights an additional benefit, as

prolonged or severe PONV can delay oral intake and hamper patient recovery [19]. Additionally, the TFP block's learning curve appears to be moderate. Residents in our institution performed the block after they had been trained on at least 10 TFP procedures under supervision, suggesting that the technique can be adopted relatively rapidly by clinicians familiar with ultrasound-guided fascial plane blocks. The consistency of the anatomic landmarks—particularly identifying the apex of the transversus abdominis muscle and the appearance of the transversalis fascia—makes TFP an attractive option in a teaching environment [20]. Yet, thorough knowledge of pelvic anatomy, robust ultrasound proficiency, and careful needle advancement under real-time imaging are imperative to minimize potential complications, such as peritoneal perforation.

Limitations, Future Directions

Despite its strengths, our study is not without limitations. First, we followed patients for only 24 hours postoperatively to capture acute pain outcomes, with a brief assessment of chronicity at three months. While this timeframe is appropriate for quantifying immediate opioid consumption and early pain scores, donor-site pain can persist for weeks or months. Longer follow-up might better elucidate whether TFP block reduces the incidence of chronic donor site pain. Secondly, our sample size, though adequately powered to detect differences in opioid consumption, remains modest. Larger, multi-institutional trials could confirm our findings across diverse patient populations and surgical contexts. Thirdly, we standardized the local infiltration of 0.25% bupivacaine in the harvest site for all participants after closure, which may have impacted analgesic outcomes. However, this was done to align with standard local infiltration practices and ensure ethical adequacy of pain management in both study arms. Future research could involve investigating the addition of adjuncts to the TFP injection—such as dexamethasone or clonidine—to prolong analgesia and further reduce opioid requirements. Comparisons with other regional techniques (e.g., lumbar plexus blocks or quadratus lumborum blocks) in the context of ICBG might also clarify the relative merits of each approach. Additionally, exploring objective measures of functional recovery and patient quality of life (e.g., validated questionnaires or time to ambulation) would greatly enhance the clinical relevance of TFP block data.

CONCLUSION

In this triple-blind, prospective randomised study, the transversalis fascia plane (TFP) block provided superior analgesia for patients undergoing anterior iliac crest bone graft (ICBG) harvesting compared with placebo. The TFP block significantly reduced intraoperative fentanyl and postoperative morphine requirements, delayed the need for rescue analgesics, and lowered pain scores over 24 hours. These improvements led to enhanced patient comfort and decreased opioid-related side effects. Our findings are consistent with other studies documenting the TFP block's reliability in targeting the T12–L1 dermatomes, which are crucial for ICBG donor-site innervation. Given its favourable safety profile, minimal complications, and ease of implementation under ultrasound guidance, the TFP block is a promising addition to multimodal analgesia protocols for surgical procedures requiring anterior ICBG.

Recommendations

Adopt the TFP block as a standard analgesic modality for surgeries requiring anterior ICBG.
Conduct larger, multi-centre trials to validate these findings and explore long-term outcomes.
Evaluate adjunct agents (e.g., dexamethasone) to further prolong TFP block analgesic duration.

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