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The effect of ultrasound-guided bilateral single shot pecto-intercostal plane block on recovery after on-pump coronary bypass graft surgery, randomized controlled trial

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Abstract
Background: Fast-track anaesthesia and ultra-fast track anaesthesia are techniques used in cardiac anaesthesia aiming for early extubation in the intensive care unit. This study assessed the efficacy and safety of pecto-intercostal plane blocks (PIFB) guided by ultrasonography following on-pump coronary artery bypass graft (CABG) surgery.
Methods: 40 Patients of both genders aged > 40 years scheduled for on-pump CABG surgery were randomly distributed either; Group I (Control group): bilateral PIFB with normal saline (1 ml), Group II (PIFB group): bilateral PIFB with local anaesthetics. The extubation time was the primary outcome while the secondary outcome were postoperative pain scores, intraoperative and postoperative opioid consumption, the ICU stay duration and the incidence of postoperative complications.
Results: There were statistically significant reductions in the extubation time, ICU length stay, intraoperative fentanyl, and postoperative morphine consumption in the PIFB group compared with the control group (P value < 0.05). Pain scores were lower in PIFB group at 2, 4, 12, 16, 20, and 24 h after extubation than Control group. Compared to the control group, the PIFB group experienced a significantly longer time to first morphine requirement as rescue analgesic analgesia. Between the two groups, there were insignificant differences in the frequency of complications, diaphragmatic dysfunction, postoperative reintubation, and 30-day mortality.
Conclusion: The intraoperative PIFB in patients scheduled for on-pump CABG surgery shortened the extubation time and the ICU length, decreased intraoperative fentanyl and postoperative morphine consumption and postoperative pain scores, prolonged 1st time of rescue analgesia.
Trial registration: ClinicalTrials.gov ID: NCT04343105 at the date of May 2020.

Keywords: Anaesthesia, cardiac surgery, recovery anaesthesia period, postoperative pain, opioid analgesia, diaphragmatic function

Introduction
Fast-track anesthesia (FTA) and ultra-fast-track anesthesia (UFTA) are techniques used for cardiac anesthesia aimed at early extubation in the intensive care unit (ICU). Postoperative extubation related to FTA occurs within 6 hours after surgery. These different approaches to cardiac anaesthesia provide a better recovery profile [1].
FTA and UFTA are easily applied without compromising patient safety, reducing postoperative hemodynamic and pulmonary complications, allowing for early extubation and mobilization, and reducing the ICU admission period [2].
In the era of FTA, reduced opioid doses or opioid freedom can be obtained with multimodal analgesia enhanced by regional anesthesia, targeting enhanced recovery after cardiac surgery (ERAS) [3, 4].
The sites to block the anterior terminal branches of the 2nd up to the 6th intercostal nerves providing anteromedial chest wall block are in two fascial planes: the first one, deep into the intercostal muscles and superficial to transversus thoracis muscles, is called the transverse thoracis block; the other, superficial to the intercostal muscles and deep into the pectoralis major muscle, is called the pecto-intercostal plane (PIFB) block [5].
Nearly 6% of cardiac surgery patients experience postoperative respiratory complications,

worsening the prognosis of patients with a less well-defined incidence of diaphragmatic dysfunction (DD) (1.2% to 60%) [6].

The erector spine plane block (ESPB) block usually the T2 to T9 spinal neurons. New blocks, such as PIFB, have been developed to address the issue of ESP's inability to block the anterior cutaneous branches of the intercostal nerves and its inability to provide sufficient anesthesia in the inner quadrants and near the sternum. For these differences between ESPB & PIFB, our institution conducted two separate studies with nearly similar primary outcomes to investigate the clinical discrepancy of different regional blocks used for perioperative analgesia in cardiac surgery to consider either ESPB or PIFB as one of the routine perioperative analgesic modalities for enhanced recovery after cardiac anesthesia protocol. Our institution performed two pilot separate studies to justify the sample size for each study to avoid any bias in the further results, especially at the time of research question hypothesis started, there were no previous randomized controlled large multicentered studies to be used to implement the required sample sizes calculation for the studies.

The first study, conducted by Mostafa TA *et al*., [7] concluded that ESPB could reduce the duration of the intensive care unit and the time it took for extubation, as well as the amount of opioids used and the postoperative pain scores. It could also prolong the first-time rescue analgesia was used, all without significantly impacting the rate of complications, re-intubation, or death. However, this study was the first one when conducted to assess the role of regional blocks in reducing DD incidence which was considered a common cause of weaning failure after cardiac surgery. This point of study analysis was one of the novelty and strength points of the research plan.

This study hypothesized that bilateral ultrasound-guided PIFB could control perioperative pain and reduce perioperative opioid consumption with the aim of early extubation and a lower incidence of postoperative DD, enhancing recovery after cardiac surgery. The extubation time was the primary outcome while the secondary outcomes were postoperative pain scores, intraoperative and postoperative opioid consumption, the ICU stay duration, and the incidence of postoperative complications.

Methods

Before enrolling the first patient in the study, a randomized, double-blind, controlled prospective clinical study was approved by the Ethical Committee of the Faculty of Medicine, Tanta University (Approval code: 33737/3/20) dated in March 2020. This study was registered on ClinicalTrials.gov (ID: NCT04343105) in May 2020 (https://clinicaltrials.gov/study/NCT04343105). Each enrolled patient signed an informed consent form that fully explained the benefits, techniques, and potential risks of the study. This study was conducted following the principles and guidelines of the Declaration of Helsinki. This study was conducted in April 2020 and ended in July 2022. The study was conducted per the CONSORT 2010 randomized controlled trial (RCT) statement guidelines and good clinical practice.

40 Patients aged greater than 40 years of both genders scheduled for on-pump CABG surgery were included in the study. The exclusion criteria were refusal to participate in the study, moderate to severe pulmonary hypertension or heart failure, poor ventricular function (Ejection fraction less than 45%) or severe arrhythmias, uncontrolled chest conditions, scheduled combined cardiac surgery, preoperative intra-aortic balloon pump, anticipated difficult airway, severe obstructive or restrictive pulmonary function test, and significant hepatic or renal dysfunction.

Patients were randomly assigned to one of the following two groups using computer-generated software, with the results placed in opaque, sealed envelopes.

Group I (Control group) received a bilateral ultrasound-guided single-shot PIFB block after induction of anesthesia with normal saline (1 ml).

Group II (PIFB group): received bilateral ultrasound-guided single-shot PIFB block after induction of anesthesia with 10 ml bupivacaine 0.5% + 10 ml lidocaine 2% in total volume 20 ml for each side.

Adequate preoperative assessment was performed for all enrolled patients (history, examination, and requested investigation), and risk stratification was performed by calculating the preoperative EuroSCORE (https://www.euroscore.org/). Cardiovascular risk factors (ventricular rhythm and function), non-cardiac risk factors (anemia and coagulation studies), and associated comorbidities were assessed and controlled. The ease of venous and arterial line access was assessed during the preoperative physical examination.

On the day of surgery, the patient was admitted to the operating room (OR) and monitored with a five-lead electrocardiograph, pulse oximetry, and noninvasive blood pressure monitoring. An 18-gauge venous cannula was inserted.

To assess diaphragmatic excursion (DE) by ultrasonography ((Philips CX 50 Extreme edition), a curvilinear probe (2–5 MHz) was used to penetrate the posterior third of the right hemidiaphragm perpendicularly while the patient was lying in the supine position. The probe was positioned in the subcostal area, halfway between the midclavicular and anterior axillary lines. In mode B, the diaphragm can be considered an echogenic line separating the surfaces of the liver and lungs. The medical practitioner instructed the patient to take a deep breath and used the M-mode to observe the diaphragm's movement and measure its excursion during the entire inhalation process.

A two-dimensional diaphragm image was obtained using the spleen window to record left hemi-diaphragmatic motion. The probe was positioned subcostal or in the last area between the anterior and posterior axillary lines to provide the finest imaging of the left hemidiaphragm. Similar to how the right side was previously stated, the motion was captured using M-mode US.

The mean bilateral excursion was 3 cm, and the lower limit values were 1.6 cm in women and 1.8 cm in men. [8, 9]

Patients with preoperatively diagnosed DD (defined as a DE less than the lower limits, as mentioned before) were excluded from the study.

The patient received sedation with midazolam (0.02-0.04 mg/kg) and fentanyl (0.5 µg/kg) with oxygen supplementation through a nasal cannula at a 2-3 L/min flow rate. The modified Allen test was performed to ensure adequate arterial supply to the hand, demonstrating collateral flow through the superficial palmar arch before cannulation. The arterial line was established under local anesthesia in the radial artery of the non-dominant hand at the start of invasive blood pressure monitoring.

After five minutes of pre-oxygenation, anesthesia was induced using an 80% oxygen well-fitting face mask. Anaesthesia induction consisted of intravenous fentanyl (5 g/kg) and a titrating dose of propofol (0.5 mg/kg) until loss of verbal contact. Rocuronium was administered at a 0.6 mg/kg concentration to facilitate tracheal intubation. Subsequently, end-tidal carbon dioxide ($EtCO_2$) monitoring was initiated, and a nasopharyngeal temperature probe was introduced. The ventilator settings were adjusted to maintain an $EtCO_2$ level between 35 mmHg and 40 mmHg. Anaesthesia was maintained using sevoflurane (concentration based on the bispectral index [BIS]). The BIS scores remained between 40 and 60. Insufficient analgesia was defined as an increase in heart rate (HR) and mean arterial blood pressure (MAP) greater than 20% above baseline values, and an IV bolus of 2 µg/kg fentanyl was administered and repeated as necessary.

Furthermore, a central line was introduced under complete aseptic precautions, with local anesthesia infiltration into the internal jugular vein using a triple-way catheter under ultrasound guidance.

The parasternal region was scanned by using a high-frequency linear ultrasound transducer (Philips CX 50 Extreme Edition). The probe was placed approximately 2 cm lateral to the midline in the third or fourth intercostal spaces. Anatomical landmarks were identified between the rib shadows (Fig. 1). Color Doppler scanning of the target area was performed to detect nearby veins or arteries and avoid intravascular injection. A 22-gauge, 8-cm needle was inserted and guided by ultrasound using an in-plane approach from lateral to medial direction.

The needle was introduced through the pectoralis major muscle until the tip reached the desired plane between the pectoralis major muscle and the external intercostal muscle. The drug was then deposited onto PIFB. The fascial plane separation and distribution of the drug could be visualized on an ultrasound image (Fig. 2).

After surgery, the patient was transported to the ICU under close monitoring. Mechanical ventilation (MV) was continued without sedation or muscle relaxation. Weaning from MV started immediately, and the hemodynamic parameters were stable without surgical complications. Patients were extubated once they fulfilled the extubation criteria and were stable for 30 minutes during a spontaneous breathing trial (SBT). During the SBT, DE was performed before extubation in the supine position. The extubation criteria were as follows: PaO_2/FIO_2 ratio > 200, $PaCO_2$ < 50 mmHg, RR < 34 breaths/min or > seven breaths/min, TV > 5 ml/kg on PS ≤ 8 cm H_2O, PEE $p\leq$ 5 cm H_2O, vital capacity > 10 ml/kg, negative maximum inspiratory pressure < - 15 to - 30 cm H_2O, Rapid shallow breathing index < 105 breaths/L, PH > 7.25, hemodynamically stable or on low doses of vasopressors or inotropes with HR < 140 beats/min or HR variability > 20%, and fully conscious, alert, or easily arousable with no signs of respiratory distress and adequate cough reflex. After extubation, oxygen supplementation was administered using an oxygen mask at a flow rate of 4 L/min. The patients received postoperative analgesia comprising paracetamol (1 g IV/6 h) and ketorolac (30 mg IV/12 h) on admission to ICU. Morphine (3 mg) was administered slowly intravenously with greater than a 20% increase in HR, or MAP, in non-extubated patients with a pain score of ≥ 4.

An anesthesia resident obtained all measurements, was blinded to the group of patients, and did not participate in the study. The PIFB was performed with an anesthesiologist who was an expert at ultrasound-guided regional blocks and was responsible also for the drug mixture used and was not responsible for the progress of cardiac anaesthesia of all enrolled patients. Another anesthesiologist was responsible for the completion of the anesthetic plan as described below in detail and was blinded to study group allocations. All included patients and surgeons in the study were blinded to study group allocation. The primary outcome was extubation time (The interval from the end of surgery until successful extubation). The secondary outcome was the numeric rating scale (NRS) (A metric score for pain assessment: 0 for no pain and 10 for worst pain), assessed immediately after successful extubation and during the first postoperative day. Total intraoperative fentanyl and postoperative morphine consumption were also measured. DE measurements were performed during the SBT and before extubation. Success in extubation was measured by sustained spontaneous breathing without noninvasive ventilation for more than 48 hours after extubation. Extubation failure was defined as the need for noninvasive breathing and reintubation within 48 hours.

The ICU stay, reintubation incidence, and 30-day mortality were assessed. The incidence of complications including cardiac (postoperative myocardial ischemia and arrhythmia), respiratory (atelectasis, pneumonia, pulmonary edema, and ARDS), renal impairment, and postoperative hematoma at the block site was measured. The self-administered satisfaction scale measured patient satisfaction scores as follows: very satisfied, somewhat satisfied, somewhat dissatisfied, and very dissatisfied.

A pilot study was conducted on ten patients (not included in the final study) who underwent on-pump CABG surgery and were randomly and equally allocated to receive sham (1 ml saline) and real PIFB blocks (Local anesthetic used). Using the real PIFB block significantly decreased the extubation time (mean [SD]) from 323 (140) min to 121 (73.7) min ($p = 0.029$). Based on the pilot study results, 16 patients were recommended for each group to measure a significant difference in extubation time of at least 90 min at an α value of 0.05 and 90% power of the study. Twenty patients were included in each group to overcome dropout.

Statistical analyses were performed using SPSS software (SPSS Inc., Chicago, IL, USA). The Kolmogorov-Smirnov test and Shapiro-Wilk tests were conducted to check the normality assumption. Categorical data were expressed as numbers and percentages and analyzed using Fisher's exact test, whereas parametric data were analyzed using an unpaired t-test and expressed as mean (standard deviation). The Mann-Whitney U test was performed for pain score assessment and expressed as the median (interquartile range). Values were considered statistically significant when the p-value was less than 0.05.

Results

59 patients were assessed for eligibility for this study; 7 declined to participate, and 12 did not meet our inclusion criteria (6 patients underwent combined cardiac surgery, 2 had severe pulmonary hypertension, 3 had poor ventricular function, and one had severe liver impairment). The remaining 40 patients were randomly assigned to two groups after successful follow-up and data analysis. The basic data of the patients, including age, gender, body

surface area, duration of surgery, and number of graft vessels, were statistically insignificant between the two groups (Table 1, Fig. 3).

The time to extubation was significantly shorter in the PIFB group than in the control group ($p< 0.0001$). Furthermore, the ICU stay was longer in the control group than in the PIFB group ($p< 0.0001$). However, the incidence of postoperative reintubation, 30-day mortality, and complications were not significantly different between the two groups (Table 2).

The incidence of postoperative DD was lower in the PIFB group than in the control group; however, the difference was not statistically significant.

The intraoperative fentanyl consumption was significantly reduced from the mean (SD) 758.5 (154.52) µg in the control group to 258.5 (54.89) µg in the PIFB group ($p< 0.0001$). In addition, postoperative morphine consumption was significantly greater in the control group than in the PIFB group ($p< 0.0001$). The time to request the first morphine analgesia was significantly longer in the PIFB group than in the control group ($p< 0.0001$; Table 2).

NRS after extubation was significantly lower in the PIFB group than in the control groups at 2, 4, 12, 16, 20, and 24 h after extubation ($p< 0.05$). However, at 8 h, the NRS score of the control group was lower than that of the PIFB group ($p = 0.015$). There was no significant difference in the NRS between the two groups immediately after and 6 h after surgery ($p> 0.05$, Table 3).

Patient satisfaction score comparisons, as presented in Table 2, revealed a statistically significant difference between the groups ($p\leq 0.0001$).

Discussion

This study showed that PIFB could provide good intra & postoperative analgesia with prolonged first-time rescue analgesia, as well as shorten the duration of ICU stay and time to extubation (Primary outcome) in cardiac patients receiving on-pump CABG surgery.

This study demonstrated the clinical reduction of postoperative DD after cardiac surgery with effective postoperative pain relief. Still, there was no statistically significant difference between the PIFB and Control group with the need for further research to ensure these results.

Inadequate postoperative pain control is a common complication of cardiac surgery. The most common post-cardiac surgery pain management protocol is patient-controlled analgesia with intravenous opioids. They could delay extubation and weaning from MV compared to regional techniques [5, 10].

Adequate perioperative pain management, especially during the first day, using regional analgesia in cardiac surgical patients helps accomplish FTA, early ambulation, and ICU discharge [4, 11].

Patient satisfaction scores were enhanced in patients extubated in the OR after ICU arrival with FTA [12].

The results of the present study agree with those of Zhang Y. *et al*., who assessed the effect of PIFB on perioperative analgesia in patients undergoing valve replacement surgery through median sternotomy. They concluded that there was a reduction in postoperative extubation time, ICU stay, and hospital stay durations after surgery in the PIFB group, thereby decreasing sufentanil consumption with effective analgesia [13].

Kumar *et al*. Investigated the efficacy of postoperative analgesia with PIFB in patients scheduled for cardiac surgery after surgery before shifting to the ICU. Patients who received PIFB reported reduced pain scores, reduced fentanyl requirements, and longer postoperative analgesia durations [14].

In the Khera T. *et al*. trial, using PIFB on the first and second postoperative days in cardiac surgical patients requiring median sternotomy, PIFB minimized opioid consumption during the first postoperative day, with a statistically insignificant difference in the 48-hour cumulative opioid requirement. The disparity in the results of previous and present studies may be attributed to the different timings of the PIFB block. The study by Khera T. *et al*. supported the present results regarding the lower incidence of postoperative adverse effects and increased pain relief, ensuring the safety and effectiveness of PIFB in cardiac surgery [15].

Many studies have demonstrated the efficacy of PIFB in perioperative pain control in chest wall surgeries, such as breast surgery [16] and thymectomy via median sternotomy, providing analgesia for rib and sternal fractures and successfully using it for difficult weaning from MV due to fracture pain [17, 18].

The methodology used in Zhang Y. *et al*.'s study was comparable to the current methodology. However, Zhang Y. *et al*. compared bilateral real or sham continuous PIFB with postoperative recordings for three successive postoperative days. In terms of reducing the duration of extubation, perioperative opioid usage, and pain scores, Zhang Y. *et al*. validated the present methods and outcomes using single-shot PIFB [19].

Another regional block performed for median sternotomy is the transverse thoracic muscle plane block (TTMPB), which is performed in the supine position. Kaya C. *et al*.'s study concluded there was no difference between PIFB and TTMPB regarding time to extubation, postoperative morphine consumption, pain scores during the first postoperative day, patient satisfaction, postoperative complications, and ICU stay duration. However, PIFB offers longer first-time rescue analgesia, which is considered an essential element of enhanced recovery after cardiac surgery [20].

Patients undergoing heart surgery suffer from phrenic nerve damage, which causes DD, especially in patients with a history of respiratory illness [21-23]. Pulmonary problems following heart surgery are common, with a frequency of 30% and a DD prevalence of up to 75% [24-25].

After cardiac surgery, temporary diaphragm impairment may be related to mechanical issues, such as sternal pain and the presence of pleural or mediastinal tubes. It may be more persistent due to the devascularization of the diaphragm or partial or total injury to the phrenic nerve [26-27]. Regional blocks, such as PIFB, offer the opportunity to exclude transient DD after cardiac surgery due to postoperative pain. PIFB provided a lower clinical incidence of postoperative DD, but there were no statistical differences in the incidence of postoperative DD and reintubation in this study.

The ICU is the final stage, where the quality of the outcome of heart surgery is ensured by the failures and mistakes of the preceding phases, which also define the duration of stay in the ICU. In 2020, the following recommendations were made for enhanced recovery following heart surgery: Following heart surgery, extended mechanical ventilation is

linked to greater rates of morbidity, death, and increased expenses. With the use of low-dose opioid anesthesia and time-directed guidelines, early extubation within six hours is safe and feasible. Anesthesia delivered in the operating room and ICU can cause a patient to become unconscious, which is one of the factors linked to prolonged ventilatory support. The cost-effective programmatic switch to an earlier extubation is linked to a shorter length of stay in the ICU. Improving postoperative pain management using multimodal analgesia techniques, helps patients return to normal sooner and with greater functioning and quality of life [28].

The most recent study by Ibrahim KS *et al*. 2024, which evaluated factors affecting the length of stay in the intensive care unit following coronary artery bypass surgery and found that prolonged ICU stay was closely correlated with prolonged ventilatory support > 12 h, strongly supports this study's finding regarding ICU stay [29].

So, early postoperative extubation with effective postoperative analgesia could explain this large statistically and clinically significant discrepancy in ICU stay. The authors explained that early weaning from mechanical ventilation with effective postoperative pain control could initiate early mobilization, respiratory physiotherapy with effective cough reflex without secretions retention, and earlier postoperative rehabilitation reducing the incidence of postoperative respiratory complications, especially pneumonia and atelectasis.

Performing a regional block for median sternotomy using PIFB may be one of the most effective and simplest procedures, with a high safety rate and without any complications such as hematoma or infection. It can be conducted in the supine position without needing the patient to change position, and perioperative analgesia can be provided in the OR ICU if there is hemodynamic instability during the perioperative or postoperative period.

This study has some limitations, as pain from the lower limb graft site or chest drain site was not covered by the PIFB, requiring additional analgesics. Perhaps not all pertinent factors influencing ICU release were taken into consideration in this study. These might include variations in post-operative care methods, patient characteristics, or problems. Large sample sizes and multi-centered studies are needed to assess the role of a regional block as a PIFB in the reduction of postoperative DD after cardiac surgery and its observed differences in ICU stay. Further studies are required to assess the optimum time of the block, either preoperatively or postoperatively, to achieve better outcomes, especially during postoperative care in the ICU. The authors suggested that local anesthetic adjuvant could be useful for prolonging and optimizing the postoperative analgesia period with lower side effects.

Table 1: Demographic data of the studied groups

	Group I (n = 20)	**Group II (n = 20)**	**P value**
Age (Year) Mean (SD)	57.4 (6.41)	57.25 (8.07)	0.948
Gender (F/M)	13 / 7	10 /10	0.523
BSA (m^2) Mean (SD)	1.74 (0.184)	1.77 (0.22)	0.694
Duration of the surgery (min) Mean (SD)	174.6 (21.39)	170.4 (32.78)	0.634
Number of grafted vessels (no., number of patients, %)	2 vessels: 4 patients (20%) 3 vessels: 16 patients (80%)	2 vessels: 3 patients (15%) 3 vessels: 17 patients (65%)	0.677

BSA: body surface area

* Denoted significant difference between groups ($p < 0.05$)

Table 2: Extubation time, intraoperative fentanyl and postoperative morphine consumption, 1st time of rescue analgesia, the incidence of postoperative mortality, reintubation, diaphragmatic excursion, and complications

		Group I (n = 20)	**Group II (n = 20)**	**P value**	**Confidence interval 95%**
Extubation time (minutes)	Mean (SD)	274.25 (7.884)	117.55 (4.695)	< 0.0001*	168.92, 222.88
	Median (IQR)	266.5 (30)	111 (23)		
Intraoperative fentanyl consumption (µg)	Mean (SD)	758.5 (154.52)	258.5 (54.89)	< 0.0001*	419.64, 375
	Median (IQR)	750 (93)	250 (75)		
Postoperative morphine consumption (mg)	Mean (SD)	13.2 (2.04)	4.2 (1.51)	< 0.0001*	7.14, 10.26
	Median (IQR)	12 (3)	3 (3)		
1st time of rescue analgesia (minutes)	Mean (SD)	132.3 (62.12)	473.05 (28.25)	< 0.0001*	247.1, 362.35
	Median (IQR)	125 (47)	472.5 (23)		
ICU stay duration (h)	Mean (SD)	70.45 (22.33)	27.1 (8.56)	< 0.0001*	39.96, 57.59
	Median (IQR)	80 (43)	27 (17)		
The incidence of postoperative mortality (no., %)		1 (5%)	0 (0%)	0.311	
The incidence of postoperative reintubation (no., %)		2(10%)	1 (5%)	0.548	
The incidence of postoperative diaphragmatic dysfunction (no., %)		5 (25%)	3 (15%)	0.435	
The incidence of postoperative complications (no, %)	Cardiac	1 (5%)	0 (0%)	0.243	
	Respiratory	1 (5%)	2 (10%)		
	Renal	0	0 (0%)		
	Hematoma formation	3 (15%)	1 (5%)		
Patient satisfaction (no, %)	Very satisfied	0 (0%)	11 (55%)	< 0.0001*	
	Somewhat satisfied	3 (15%)	9 (45%)		
	Somewhat dissatisfied	15 (75%)	0 (0%)		
	Very dissatisfied	2 (10%)	0 (0%)		

* Denoted significant difference between groups ($p < 0.05$)

Table 3: Postoperative Numerical Rating Score (NRS)

NRS after extubation	Group I (n = 20)	Group II (n = 20)	P value
Immediately (Median, Q1, Q3)	1 (1,2)	1 (1,1)	0.294
2 h (Median, Q1, Q3)	4 (2,4)	1 (1,2)	< 0.0001*
4 h (Median, Q1, Q3)	2 (1.25, 4)	1.5 (1, 2)	0.027*
6 h (Median, Q1, Q3)	2 (1.25, 2)	2 (2,3)	0.139
8 h (Median, Q1, Q3)	2 (2, 3.75)	4 (3,4)	0.015*
12 h (Median, Q1, Q3)	4 (2,4)	2 (2,2)	0.001*
16 h (Median, Q1, Q3)	3 (3,3)	2 (2,2.75)	< 0.0001*
20 h (Median, Q1, Q3)	3 (3,3)	2 (2,3)	< 0.0001*
24 h (Median, Q1, Q3)	3 (3,3)	2 (2,3)	0.005*

* Denoted significant difference between groups ($p < 0.05$)

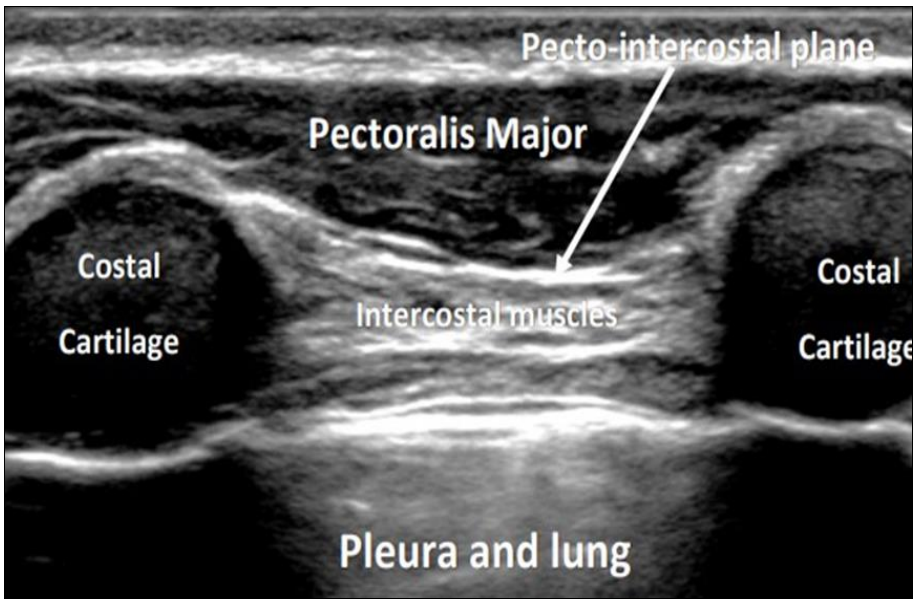

Fig 1: Scanning of the parasternal region using a high-frequency linear ultrasound transducer showing the anatomical landmarks inbetween rib shadows as follows: skin, subcutaneous tissue, pectoralis major muscle, intercostal muscles, pleura and lung.

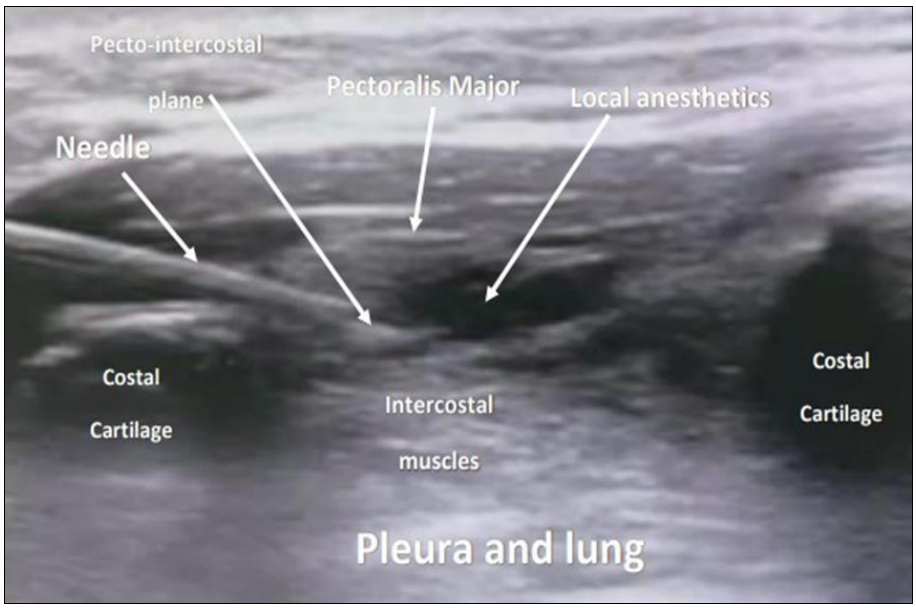

Fig 2: The needle insertion in in-plane approach at the pecto-intercostal plane with the fascial plane separation and the distribution of the drug.

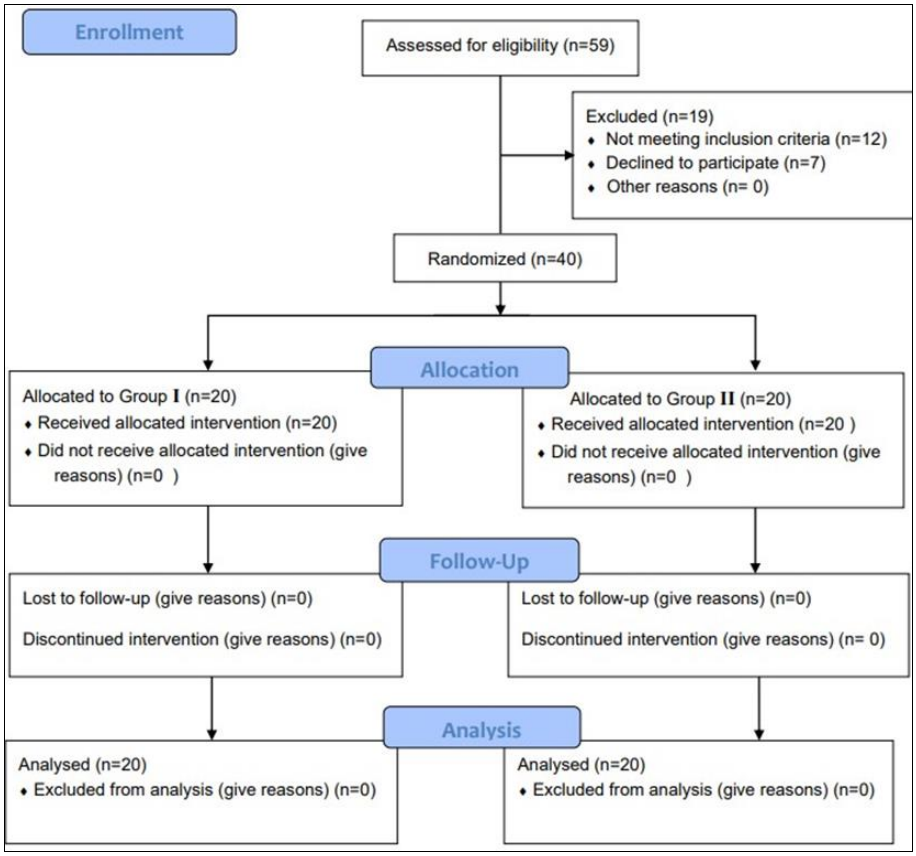

Fig 3: CONSORT flow chart of the study

Conclusion

The intraoperative ultrasound-guided PIFB in patients scheduled for on-pump CABG surgery shortened the extubation time and the length of ICU stay, decreased intra-postoperative opioid consumption and postoperative pain scores, and prolonged 1st time of rescue analgesia.

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Declaration of interests: Nil

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