Original Research Article

Ultrasound-Guided Continuous Serratus Anterior Plane Block Versus Ultrasound-Guided Continuous Thoracic Paravertebral Block for Analgesia in Multiple Traumatic Rib Fractures

Abstract

Background: Rib fractures are the most common of all chest injuries. The aim of study was comparing the analgesic efficacy of ultrasound (US)- guided continuous serratus anterior plane (SAP) block and ultrasound- guided continuous thoracic paravertebral block (TPVB) in patients with multiple traumatic rib fractures.

Methods: This prospective randomized study was conducted over 70 patients of either sex aged between 22-65 years with unilateral multiple traumatic fracture ribs (≥ 3 fractured ribs) in ICU. Patients were randomly allocated into two equal groups (35 patients each): Group I (TPVB): received US guided continuous TPVB using bupivacaine 0.25% for 4 days. Group II (SAP block): received US-guided continuous SAP block using bupivacaine 0.25% for 4 days. Pain severity using visual analogue scale (VAS) at rest and on coughing, respiratory rate (RR), pulmonary function tests, arterial blood gases were measured before and after administration of the blocks at regular intervals. Hemodynamic changes, rescue morphine analgesic dose, length of hospital stay and complications of the two techniques were also recorded.

Results: Both blocks provided significant decrease in VAS scores at rest and on coughing at all assessment times after blocks as compared to the pre-block values (P value< 0.05). There was no significant difference between both groups regarding the VAS scores at rest and on

coughing. Both blocks provided significant decrease in RR and increase in FVC and FEV1 after blocks as compared to pre-block values (P value< 0.05). Continuous SAP block and TPVB provided significant increase in PaO_2, SaO_2 after both blocks as compared to pre-block values (P value< 0.05). There was no significant difference between both groups regarding morphine requirements, pulmonary functions and ABG parameters. SAP block had shorter block performance time and better needle visibility score than TPVB.

Conclusions: Continuous SAP block is a safe and effective alternative to the TPVB for pain relief in patients with unilateral multiple fracture ribs. Both techniques improved the pulmonary functions and the arterial oxygenation without side effects. The SAP block had shorter block performance time with better needle visibility score than the TPVB.
Keywords: Ultrasound Guided, Serratus Anterior Plane Block, Thoracic Paravertebral Block, Rib Fractures

Introduction:

Rib fractures are the most common of all chest injuries and occur in up to 80% of patients with blunt chest trauma. [1] Effective analgesia started promptly prevents hypoventilation, enables deep breathing, adequate coughing with clearance of pulmonary secretions. Overall, this reduces secondary pulmonary complications including atelectasis, pneumonia, respiratory failure, and the need for respiratory support. [2]

A combination of adequate pain control, respiratory assistance, and physiotherapy are considered to be the key in the management of patients with fractured ribs. [3] In the current practice, different analgesic modalities including epidural catheters, intravenous (IV) narcotics, intercostal, paravertebral or intrapleural blocks, oral opioids or a combination of the mentioned interventions are used for pain management. [4, 5]

Thoracic paravertebral block (TPVB) has been used for pain relief of multiple rib fractures through injecting a local anesthetic agent close to where the spinal nerves exit the intervertebral foramina, it can provide high-quality ipsilateral, segmental, somatic, and sympathetic nerve blockade. [6]

Serratus anterior plane (SAP) block is first described by Blanco and colleagues [7] for surgery performed on the anterolateral chest wall as breast surgeries, it aims to provide anesthesia of the hemithorax. We proposed that SAP block may be an effective alternative to other regional anesthetic techniques for patients with multiple fractured ribs.

The aim of this study is to compare the analgesic efficacy of ultrasound (US)- guided continuous SAP block and US- guided continuous TPVB in patients with multiple traumatic rib fractures.

Patients and Methods:

Our prospective randomized study was conducted over 70 patients aged between 22-65 years with unilateral traumatic multiple fracture ribs (≥ 3 fractured ribs) at surgical ICU,

Tanta University Hospitals from December 2018 to June 2020 after approval from Ethical Committee(32596/09/18) and obtaining informed written consent from each patient.

Exclusion criteria were contraindications to regional block such as patient's refusal, coagulopathy, local infection at the site of the block, known allergy to local anesthetic drugs. Patients suffer from severe cardiovascular, hepatic or renal diseases, patients had indications for mechanical ventilation on admission or during the study period were also excluded.

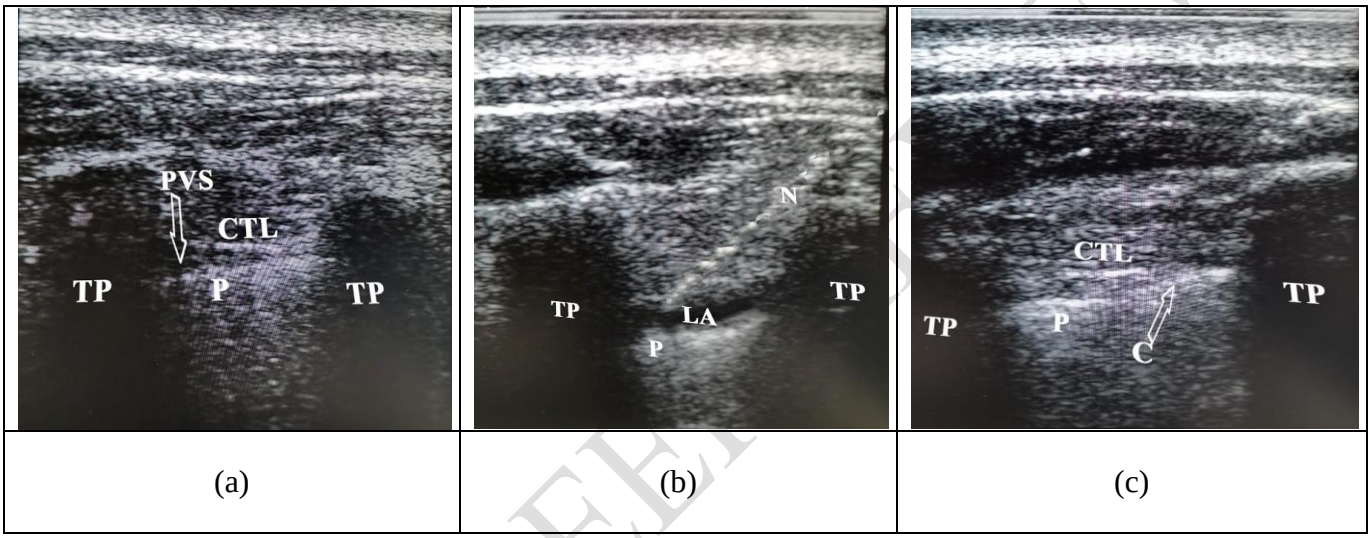
Patients were randomly allocated into two equal groups (35 patients each) by computer generated sequence through sealed opaque envelopes. Group I (TPVB): Patients received US-guided continuous TPVB using bupivacaine 0.25% for 4 days. Group II (SAP block): Patients received US-guided continuous SAP block using bupivacaine 0.25% for 4 days.

Ultrasound-guided thoracic paravertebral block technique:

The US guided TPVB was performed with the patient in sitting position under complete aseptic precautions and sterilization using povidine iodine disinfectant solution 10%. US-guided TPVB was performed at the vertebral level of the middle fractured rib. A high frequency (6-11 MHz) US probe **(sonoscape SSI-6000, China)** was applied in the vertical plane 2.5 cm lateral to the spinous process with its orientation directed cranially. This US paramedian sagittal scanning allowed the identification of the transverse process (TP), the costotransverse ligament, the pleura and the lung dynamically.

Entry site of skin and subcutaneous tissue was infiltrated with 3 ml of 2% lidocaine. Using an in-plane approach, a 18 gauge epidural Tuohy needle (Perifix, B Braun, Germany) was introduced between 2 corresponding TPs in a caudo-cranial direction and positioned past the costotransverse ligament and posterior to the parietal pleura. After negative aspiration for blood, 3 mL of normal saline was slowly injected. The injection of saline was visualized and the correct position of the needle was confirmed by seeing the saline volume pushing the pleura anteriorly**.** [(8)]

Bolus dose of 0.25% bupivacaine (0.3 ml/kg) (Sunnypivacaine vial 0.5%, sunny pharmaceuticals, Egypt) was injected slowly over 3-5 minutes. An epidural catheter was inserted through the tuohy needle and advanced 3cm into the PVS. At 30 minutes after injection of loading dose, the dermatomal loss of sensation to pinprick was tested. Patients who reported pain to pinprick were considered to have a failed block and were excluded from the study. The block was maintained by continuous infusion of bupivacaine 0.25% at rate of 0.1 ml/kg/h via syringe pump**.** The infusion was continued for 4 days.



(a) (b) (c)

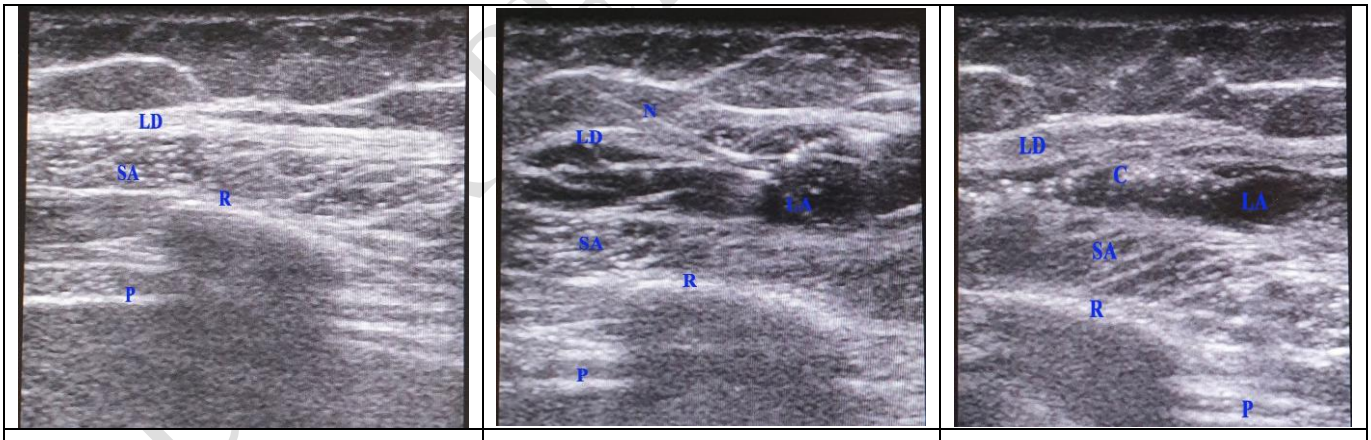
Figure 1: a) Paramedian sagittal scan of TPVS, b) Injection of the local anesthesia in PVS pushing the pleura downward, c) Catheter inserted through the needle in TPVS, TP; transverse process, CTL; costotransverse ligament, PVS; paravertebral space, P; pleura, LA; local anesthetic, N; needle, C; catheter.

Ultrasound-guided serratus anterior plane block technique:

Under complete aseptic precautions and sterilization using povidine iodine disinfectant solution 10%, the block was performed with the patient in the supine position and the arm abducted. A high-frequency linear US probe (6-11 MHz) **(sonoscape SSI-6000, China)** was placed in the sagittal plane over the midclavicular region of the chest wall. Ribs were counted inferiorly and laterally until identifying the fifth rib in the mid-axillary line. Latissimus dorsi (superficial) and serratus anterior (deep) muscles were identified overlying the fifth rib. An

extra reference point, the thoracodorsal artery passing in the superficial plane to serratus anterior was used.

Entry site of skin and subcutaneous tissue was infiltrated with 3 ml of 2% lidocaine. A 18 gauge epidural Tuohy needle (Perifix, B Braun, Germany) was advanced in-plane with the US beam till the tip was located between latissmus dorsi muscle and serratus anterior muscle. After negative aspiration for blood, 3 mL of normal saline was slowly injected. The injection of saline was visualized, and the correct position of the needle was confirmed. Bolus of 30 ml of 0.25% bupivacaine was injected slowly over 3-5 minutes between latissmus dorsi muscle and serratus anterior muscle**.** Then a catheter was inserted through the tuohy needle and advanced 3cm into the space and secured in place. At 30 minutes after injection of loading dose, the dermatomal loss of sensation to pinprick was tested. Patients who reported pain to pinprick were considered to have a failed block and were excluded from the study. The block was maintained by continuous infusion of bupivacaine 0.25% at rate of 0.1 ml/kg/h via syringe pump. The infusion was continued for 4 days.



(a) (b) (c)

Figure 2: a) Ultrasound view of serratus anterior muscle and latissmus dorsi muscle, b) Local anesthetic injection between serratus anterior and latismus dorsi muscle, c) Catheter inserted through the needle after injection of loading dose of local anesthetic. SA; serratus anterior, LD; latissmus dorsi, R; rib, P; pleura, N; needle, LA; local anesthetic, C; catheter.

Patients care

On admission to the ICU, patients received O_2 using nasal cannula at a rate of 4 L/min and monitored with ECG, pulse oximetry and noninvasive blood pressure. An IV access with a 18 G cannula was established in all patients before the block and arterial line was inserted using 20 G cannula. They were subjected to complete physical examination and laboratory assessment of the coagulation profile (prothrombin time, partial thrompoblastin time, INR and platelet count), liver and renal function, serum electrolytes, complete blood picture and arterial blood gases (ABGs).

Both blocks, TPVB and SAP block, were performed in the ICU by the same investigator. The blocks were performed after ensuring hemodynamic stability and insertion of the chest tube if needed.

Respiratory care in the form of regular chest physiotherapy was performed to all patients. The patients were encouraged to cough out secretions and perform deep breathing exercise. Serial chest X-Ray was taken on alternate days for all patients. Sputum, urine and blood samples for culture and sensitivity were taken from patients who developed fever or other signs of infection.

After four days, systemic analgesics in the form of paracetamol 1 gm IV every 8h and ketorolac 30 mg slowly IV every 12h were started and the local anesthetic infusion was gradually tapered off over a period of six hours. When the patients were completely off local anesthetic infusion and remained pain free on systemic analgesics with no other indications of ICU care, catheters were removed and they were shifted to surgical ward. Patients were followed up every day in the surgical ward until the time of discharge from the hospital.

Measurements:

Pain was assessed at rest and on coughing using the VAS on a scale from 0 (no pain) to 100 (worst pain) before the block, 30 minutes, 60 minutes after the block and then every six

hours for 4 days. But in order not to interrupt the sleeping pattern of patients, patients were considered pain free (VAS= 0) if they were at sleep with no tachypnea, tachycardia or hypertension. Rescue analgesia was provided with morphine (0.05 mg/kg) intravenously if visual analogue score (VAS) ≥ 40**.**

Respiratory rate (RR), arterial oxygen saturation (SaO_2) and ABG were measured in the following times: before block, 30 minutes, 60 minutes after block performance and then every eight hours for 4 days.

Respiratory function including forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) were assessed using bedside spirometry (spirOx plus, MEDITECH, China) before block, 30 minutes, 60 minutes after the blocks and then every eight hours for 4 days.

Heart rate (HR) and mean arterial blood pressure (MAP) were recorded at regular intervals: pre-block, then every 10 minutes during the 1^{st} hour after block. If hypotension occurs, it was managed with intravenous fluid (10 ml/kg crystalloids) and ephedrine (6 mg increments) if needed. Hypotension was defined as decrease in MAP more than 20% of the baseline value.

The total consumption of morphine were recorded. Incidence of respiratory complications, such as pneumonia or collapse, was recorded. Need for mechanical ventilation and mortality rate were recorded. Analgesia technique and catheter insertion related complications such as hypotension, bradycardia, pneumothorax, nausea and vomiting, were recorded. Length of ICU stay and hospital stay and block performance time (minutes) were recorded.

Needle visibility score, was recorded on a 3 points scale (1 = poor, 2 = good, 3 = excellent). Visualization of the whole needle or at least the tip of the needle adjacent to the

target was considered as an excellent, visualization of "non" of the needle as poor and the rest of partial views of the needle as good. [9]

Sample size:

The sample size was calculated using epi_info software computer program created by center of disease prevention and control, Atlanta, USA, WHO, Georgia, version 2002. The calculation of the sample size was based on the degree of pain scores during the first 4 days after initiation of the TPVB or SAP block. Based on the results of Giang et al [10], 30 patients were needed in each group. The calculation of the sample size was based on the following criteria: 95% confidence limit, 95% power of the study, a margin of difference of 20 mm of the VAS score between both groups and effect size of 0.95. 35 patients were recruited in each group to avoid the dropout cases.

Statistical analysis

The data was analyzed with the SPSS v25 (IBM©, Chicago, IL, USA). Normality of data was checked with Shapiro-Wilks test. Quantitative parametric variables were presented as mean ± standard deviation (SD). They were analyzed using unpaired student's t- test for the comparison between the two groups and ANOVA with repeated measures for the analysis within the same group. Qualitative variables were presented as patient's number and (%) and were analyzed utilizing the Chi-square test. The level of significance was adopted at $p < 0.05$.

Results:

In this study, 84 patients were assessed for eligibility, 9 patients did not meet the inclusion criteria and 5 patients refused to participate in the study. The remaining 70 patients were randomly allocated into two groups (35 patients in each one). All 70 patients were followed-up and analyzed statistically. Figure 1

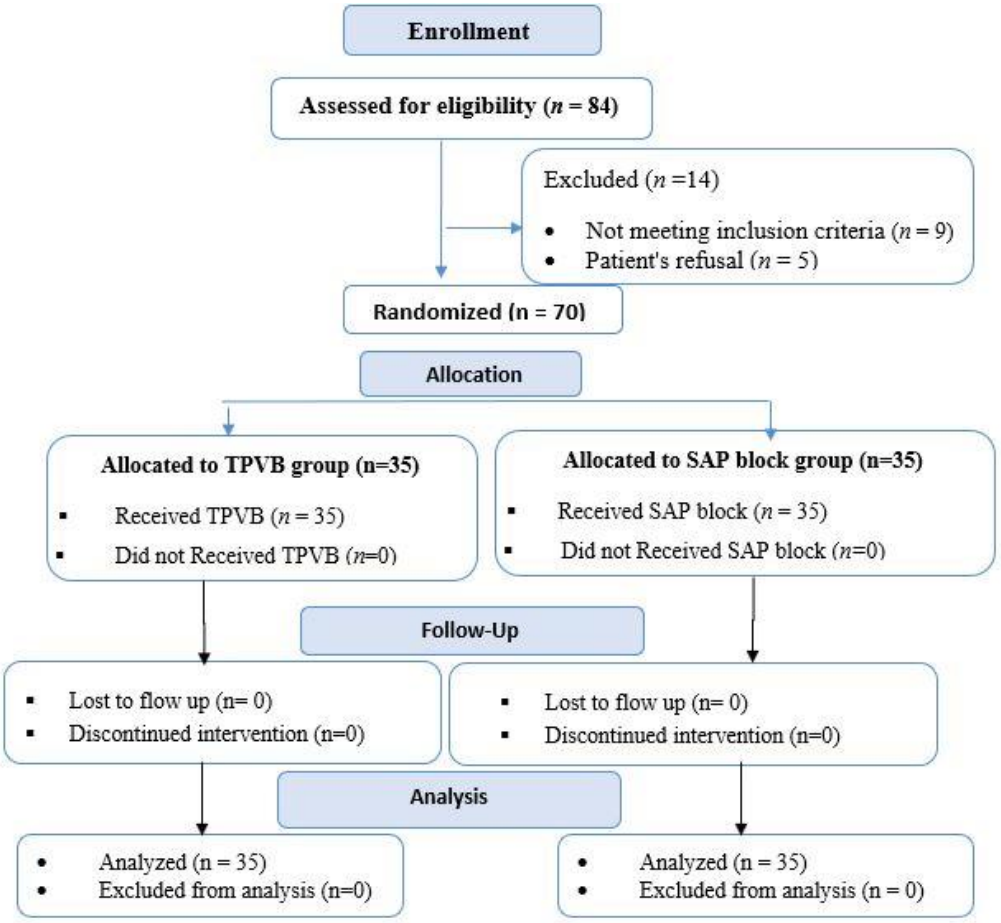


Figure 3: CONSORT flow diagram of the participants through each stage of the randomized trial.

The demographic data and patients characteristics including age, weight, gender, number of fractured ribs, side of fracture , number of patients with flail segment, number of patients with hemothorax, pneumothorax, hemopneumothorax and chest tube drainage at time of admission were insignificantly different between both groups. (P value 0.219, 0.067, 0.771, 0.678, 0.631, 0.495, 0.597, 0.743, 0.788, 0.81) respectively. . **Table 1**

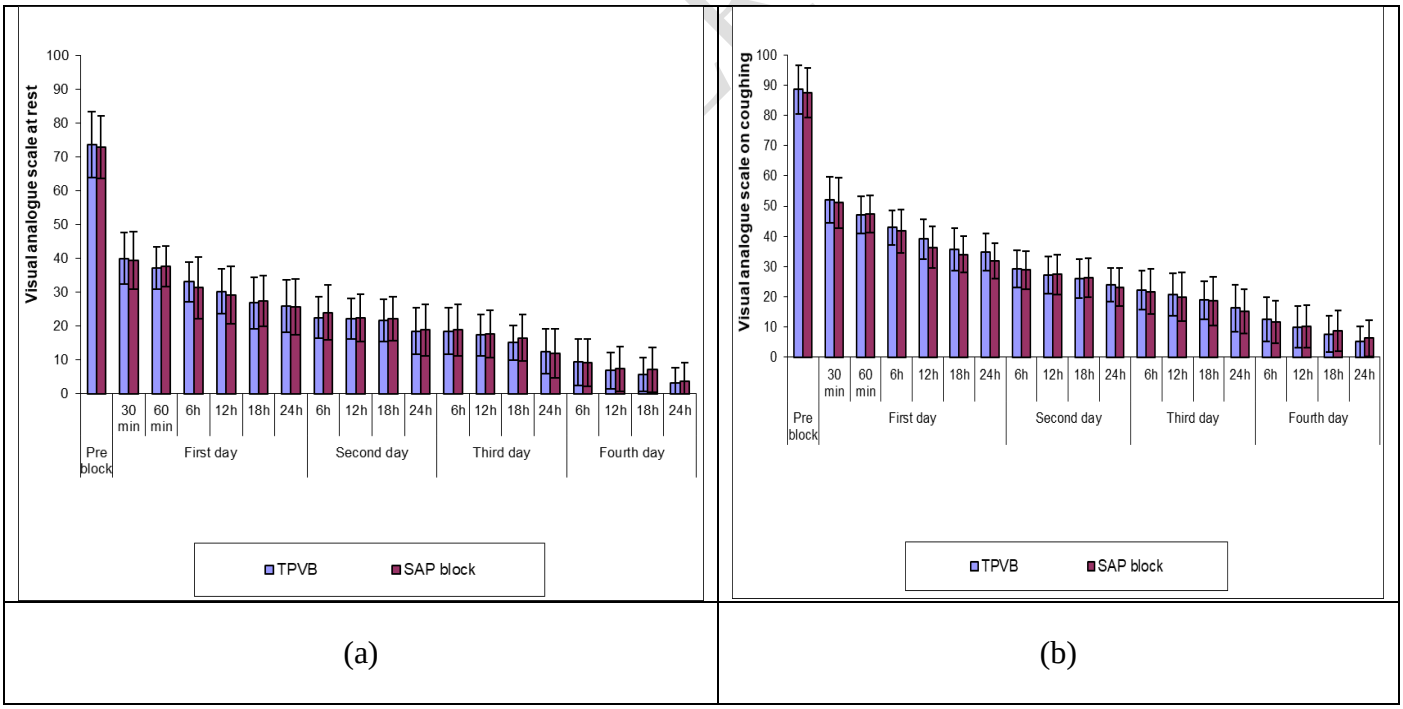
Table 1: Demographic data.

		TPVB (N=35)	**SAP block (N=35)**	**Test**	**P. value**
Age (years)		35.50 ± 10.03	38.80 12.12	t: 1.239	0.219
Weight (kg)		72.40 ± 6.65	75.20 ± 5.93	t:1.856	0.067
Gender	Male (%)	27 (77.1%)	28 (80%)	X^2: 0.082	0.771
	Female (%)	8 (22.9%)	7 (20%)		
Number of fractured ribs		5.05 ± 1.12	4.86 ± 1.17	t:430	0.678
Side of rib fracture	Right (%)	18 (51.4%)	20 (57.1%)	X^2: 0.233	0.631

	Left (%)	17 (48.6%)	15 (42.9%)		
Flail segment		6 (17.1%)	4 (11.4%)	X^2: 0.467	0.495
Hemothorax	N (%)	11 (31.4%)	9 (25.7%)	X^2: 0.28	0.597
Pneumothorax	N (%)	6 (17.1%)	5 (14.2%)	X^2: 0.108	0.743
Hemopneuomothorax	N (%)	9 (25.7%)	10 (28.6%)	X^2: 0.072	0.788
Chest tube	N (%)	16 (45.7%)	15 (42.9%)	X^2: 0.058	0.81
Block performance time		12.65±1.47	8.46±1.06	t: 13.56	<0.001*
Morphine consumption		9.54±5.77	10.27±7.11	t: 0.563	0.575
Length of ICU stay		5.86±0.83	6.17±0.97	t: 1.721	0.09
Length of hospital stay		8.68±1.75	9.08±1.85	t: 0.834	0.407

Data are presented as Mean ± SD or number (%), T: X^2

The pre-block VAS scores at rest and on coughing were insignificantly different between the TPVB group and the SAP block group (p value= 0.707 and 0.559 respectively) . Within each group, the VAS scores at rest and on coughing were significantly decreased after initiation of the block as compared to the pre-block value (P <0.05). The comparison of VAS scores at rest and on coughing between both groups were insignificantly different throughout the study period (P > 0.05). **Figure 4**



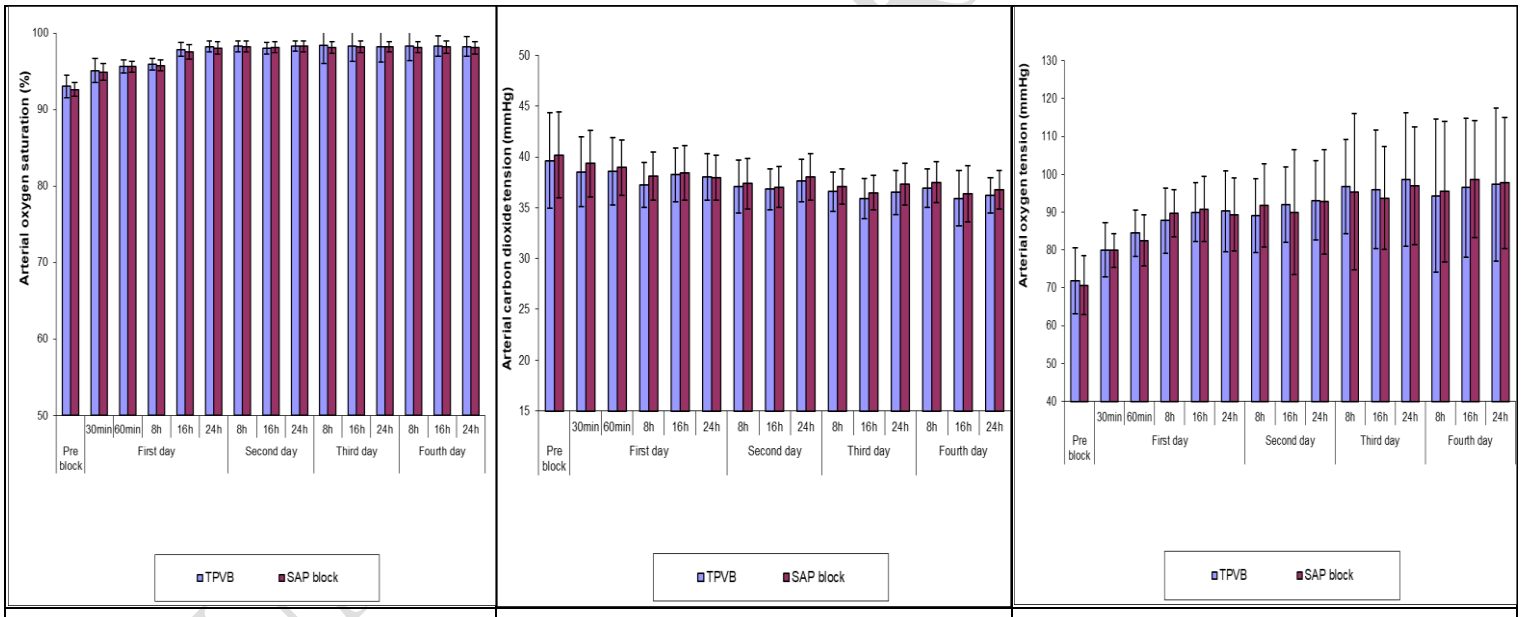
(a) (b)

Figure 4: (a): VAS scores at rest (b): VAS scores on coughing in both groups. Data presented as mean ± SD.

Both blocks resulted in a significant decrease in RR (breaths/min) and HR (beats/min) values after initiation of the blocks as compared to the pre-block value (P < 0.05). The MAP

values within each group were insignificantly different after initiation of the block as compared to the pre-block value (P > 0.05). The RR , HR and MAP values were insignificantly different between both groups at all-time points (P > 0.05).

Just before analgesia, the corresponding values of the various arterial blood gases parameters of both groups were statistically comparable. Within each group**,** the values of SaO_2 and PaO2 were significantly increased after initiation of the block as compared to the pre-block value (p value < 0.05). The comparison of SaO_2 and PaO2 between both groups was insignificantly different throughout the study period (P > 0.05). The PaCO2 values were significantly decreased starting from 8h after performance of both blocks as compared to the pre-block value (P < 0.05). The PaCO2 values were insignificantly different between both groups at all-time points (P > 0.05). **Figure 5**



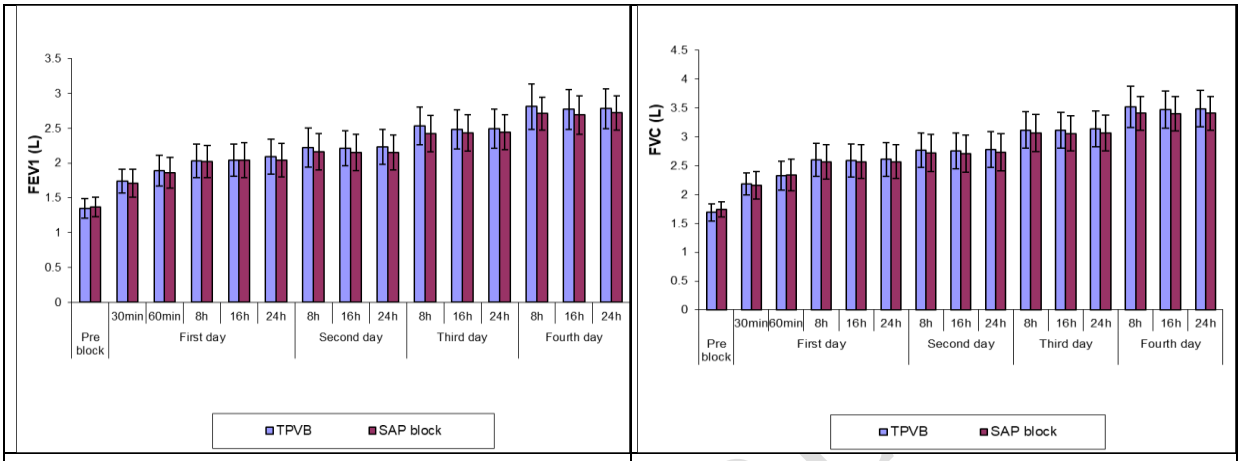
(a) (b) (c)

Figure 5: (a) Arterial oxygen saturation (%) (b) Arterial carbon dioxide tension (c) Arterial oxygen tension changes in both groups.

Data presented as mean ± SD.

The pulmonary function tests were significantly improved after start of analgesia in both groups. The pre-block FEV1 and FVC values were insignificantly different between the

TPVB group and the SAP block group. Within each group, the FEV1 and FVC values were significantly increased after initiation of the block as compared to the pre-block value (P value < 0.05). The comparison of FEV1 and FVC between both groups was insignificantly different throughout the study period (P value > 0.05) (Figure 6).



(a) (b)

Figure 6: (a) FEV1 changes (b) Forced vital capacity changes in both groups.

Needle visibility score was significantly better in the SAP block group as compared to the TPVB group (P < 0.001). **Table 2**

Table 2: Needle visibility score in both groups

Needle visibility score	**TPVB group**		**SAP block group**	
	N	**%**	**N**	**%**
Score 1	2	5.7	0	0
Score 2	20	57.1	5	14.3
Score 3	13	37.1	30	85.7
X^2 test	17.716			
p. value	< 0.001*			

The incidence of nausea and vomiting, Pneumonia and need for mechanical ventilation were insignificantly different between both groups. The block performance time was significantly shorter in SAP block group as compared to TPVB group (p<0.001). The total dose rescue morphine consumption, length of ICU stay and hospital stay were insignificantly different between both groups (Table 3).

Table 3: The incidence of side effects, block performance time, morphine consumption, length of ICU stay and hospital stay in both groups.

Measurement	TPVB group (N=35)		SAP block group (N=35)		Test	p. value
	N	%	N	%		
Nausea and vomiting	2	5.7	1	2.9	0.349	0.555
Hypotension	2	5.7	0	0	2.059	0.151
Pneumonia	2	5.7	3	8.6	0.224	0.643
Need for mechanical ventilation	2	5.7	1	2.9	0.349	0.555
Block performance time (min)	12.65±1.47		8.46±1.06		t: 13.56	<0.001*
Morphine consumption (mg)	9.54±5.77		10.27±7.11		t: 0.563	0.575
Length of ICU stay	5.86±0.83		6.17±0.97		t: 1.721	0.09
Length of hospital stay	8.68±1.75		9.08±1.85		t: 0.834	0.407

Data presented as mean ± SD or number (%)

Discussion

In this study, both TPVB and SAP block were found to be similarly effective in reducing pain scores at rest and on coughing. Both techniques lead to improvement in respiratory parameters including RR, pulmonary function tests and arterial oxygenation. Also, HR and MAP values were insignificantly different between both groups. TPVB and SAP block showed similar outcome in terms of length of ICU and hospital stay and pulmonary complications. However, SAP block had shorter block performance time and better needle visibility score than TPVB.

Up to date there is no available trial comparing the effectiveness of continuous TPVB versus continuous SAP block in patients with multiple traumatic rib fractures. However, the analgesic efficacy of both blocks had been compared in thoracotomy and breast surgeries [11, 12].

The analgesic efficacy of the continuous SAP block in patients with multiple fracture ribs had been evaluated by Jadon et al [13] who assessed the analgesic effects of continuous SAP block on Six patients with unilateral multiple rib fractures. Their results showed that all

the patients had pain relief at rest and on coughing following the block with sustained improvement for the following 3-5 days of continuous infusion. No additional doses of analgesics were required.

Also, Hernandez et al [14] evaluated the impact of SAP block on pain scores and incentive spirometry volumes after chest trauma. 34 patients aged 17 years or older with three or more consecutive rib fractures received US-guided SAP block for pain control using 20 to 40 ml of local anesthetic. They reported that SAP block may offer a viable alternative to neuraxial techniques with a better safety profile. Also, their results revealed that SAP block provided significant increase in incentive spirometry volumes at 4h, 24h and 48h after the block. Also, RR was significantly decreased after the block. These improvements were sustained for 48 h study period.

However, Jadon et al [15] reported that continuous SAP block failed to relief pain in 2 patients presented with multiple fracture ribs. They attributed that failure to the posterior location of the fracture towards the spine and inability of local anesthetic to reach up to posterior chest wall and block the pain sensation from the fractured sites.

The analgesic efficacy and improved pulmonary function of TPVB in patients with multiple traumatic rib fracture was previously documented in many Studies. [16, 17]. Karmakar *et al* [18] conducted a study to evaluate the efficacy of a continuous TPVB for pain management in 15 patients presented with unilateral multiple fractured ribs. They revealed that there was significant improvement in pain scores at rest and during coughing after initial injection and was sustained for the 4 days that the thoracic paravertebral infusion was in use. None of the patients exhibited clinical signs of local anesthetic toxicity. They also reported significant decrease in RR and significant increase in FVC after the block.

Also , Mohta et al [19] compared the analgesic efficacy of continuous thoracic epidural and TPVB infusion in 30 patients presented with unilateral multiple fractured ribs. They

showed that both thoracic epidural block and TPVB provided good pain relief, equal morphine consumption and improved respiratory function.

Moreover, Ahmed et al [20] compared and evaluated the efficacy of US-guided continuous TPVB using bupivacaine versus continuous IV morphine infusion for pain relief in patients with unilateral multiple fracture ribs. Their study included 70 patients of both sexes, aged 18–60 years with unilateral three or more ribs fracture. Their results documented that VAS scores at rest, with deep breathing and on coughing were significantly decreased 30 min after the block with sustained improvement for 72h of the study period. Their results also revealed significant decrease in RR and significant increase in FVC and FEV1 after TPVB with sustained improvement through the all study period..

In addition, Yeying et al [21] assessed the effect of continuous TPVB on pain management and preservation of pulmonary function compared with IV patient-controlled analgesia in 90 patients with multiple rib fractures. They revealed that TPVB was superior to IV patient-controlled analgesia in pain relief at rest and on coughing. Also, their results demonstrated that FVC, FEV1/FVC ratio and peak expiratory flow rate were increased post TPVB and sustained improvement for 72 h study period

The analgesic effect of TPVB is explained by direct penetration of local anesthetic into the spinal nerves, including the dorsal ramus, the rami communicates and the sympathetic chain leading to ipsilateral, segmental, somatic, and sympathetic nerve blockade.

Concerning ABG parameters, our results revealed that continuous SAP block and TPVB provided significant increase in PaO_2, SaO_2 after both blocks as compared to pre-block values. There was no significant difference between the two groups regarding ABG parameters.

In agreement with our results, Karmakar et al [18] demonstrated a significant increase in SaO_2 at 30 min after initial injection of TPVB in 15 patients with fracture ribs and these

improvements were sustained for the 4 days that the thoracic paravertebral infusion was in use.

Also, shukla et al [22] and Yeying et al [21] results revealed that PaO_2 showed persistent improvement from baseline started 30 min after TPVB and sustained for the all infusion period.

The efficacy of SAP block in improving oxygenation in patients with fracture ribs had been proved in the trail done by Hernandez et al [14]. Their results demonstrated significant improvement in SaO_2 values within 24 h after initiation of continuous SAP block in 34 patients presented with unilateral multiple fracture ribs.

Concerning block performance time, our results revealed that SAP block had shorter block performance time than TPVB. Aly et al [23] compared single shot US-guided SAP block and TPVB for postoperative analgesia after thoracotomy. They reported that the time to perform SAP block was significantly shorter than that of TPVB.

Another randomized controlled trial performed by Jain et al [24] who compared the analgesic efficacy of US-guided TPVB, SAP block and PEC II block for breast surgeries. They found that the time to put the block was significantly less in SAP block group than in TPVB group.

Our study revealed that both blocks are safe with no significant difference between both blocks regarding side effects and complications. The safety of TPVB in multiple fracture ribs was shown by Karmakar et al [18], Shukla et al [22], Mohta et al [19], Giang et al [10] and Ahmed et al [20] and the safety profile of SAP block in fracture ribs was demonstrated by Jadon et al [13], Hernandez et al [14] and Durant et al. [25].

Unfortunately, our study has some limitations. First, the study was not double blinded. Second, we didn't measure plasma levels of bupivacaine after prolonged infusions. Third, we did not compare number of blocked dermatomes after both blocks.

Conclusions:

Continuous SAP block is a safe and effective alternative to the TPVB for pain relief in patients with unilateral multiple fracture ribs. Both techniques improved the pulmonary functions and the arterial oxygenation without side effects. The SAP block had shorter block performance time with better needle visibility score than the TPVB.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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