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Serratus Anterior Plane Block For Multiple Rib Fractures-A Novel Pain Management Technique

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Abstract
Context
Rib fractures are mostly traumatic. Commonly seen in patients suffering from multiple injuries due to road traffic accidents or fall from height, conventional treatment is with intravenous/oral analgesics or opioid patches. The innervation of the ribs pass through the Serratus Anterior Plane and hence we aim to administer anaesthetic in this plane to achieve reliable and quality pain relief
Methods and materials:
20 patients presenting with a rating of 8 on the visual analogue scale , whose pain was not relieved by intravenous analgesics and showed signs of rapid shallow breathing were administered SAPB unilaterally using ultrasound guidance after written informed consent.
Results:
The patients pre-block median pain scores were. 60 minutes Post block the median pain scores were. There were no complications due to the block the the 24 hour post block period was uneventful
Conclusions:
Patients with multiple rib fractures (MRF) can be treated with SAPB with very good results, and should be tried when patients are in severe pain not responding to intravenous anaesthetics and with deterioration of pulmonary function
Keywords: *Regional anesthesia, rib fractures, serratus anterior plane block, ultrasound*

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I. Introduction

Rib fractures are mostly traumatic. Commonly seen in patients suffering from multiple injuries due to road traffic accidents or fall from height, occasionally from cardiopulmonary resuscitation done on the ribs instead of the sternum.

Statistically upto 10% of patients presenting to the emergency department complain of Multiple rib fractures (MRF) often in conjunction with other trauma.1

Thus far this condition was treated by multi-modal analgesia-intravenous/oral/opioid patches. MRF is a major cause of morbidity in patients will multiple injuries. It can lead to flail chest and splinting, which can compromise the respiration and lead to complications and deterioration of overall patient well being. Opioids are not always advisable and sometimes detrimental in patients with pre-existing pulmonary disease. This leads to inadequate pain management . 2

The definitive treatment of MRF is a thoracic epidural for continuous infusion of analgesia, but this is not always easy or possible in all patients due to issues like coagulopathy, technical difficulties, need for monitoring and lack of cooperation due to need for positioning of patient due to the pain.3,4

Ultrasound-guided Serratus Anterior Plane Block (SAPB) is a new plane block which can be used for surgeries involving musculoskeletal region of anterior chest wall.5,6

SAPB is a single shot block that is relatively easier to administer, does not require elaborate patient positioning , can be learnt easily and done in the emergency department and emergency operation theatres. 7,8

Here we aim to use SAPB to provide localized pain relief that can last for upto 48 hours. If given in the acute phase of pain, it can improve pulmonary function and provide excellent pain relief that may not be possible with other methods.

II. Methods

20 patients with MRF of 2 or more , who had Visual analog scale (VAS) score of 7 or more persistently even after intravenous analgesia and gave their consent for the SAP block were taken into consideration for the study after written informed consent.

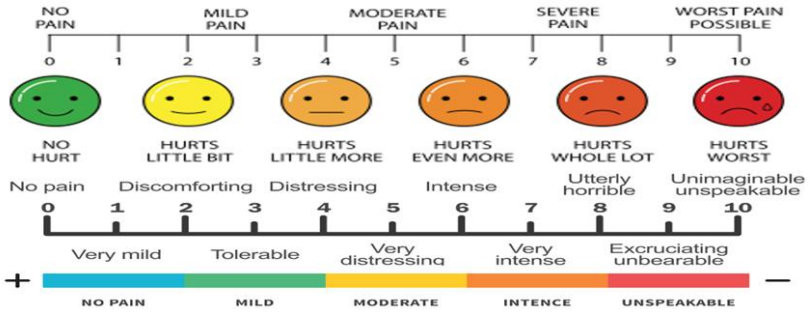


Figure 1: represents the Visual Analogue scale (VAS scoring) which was used in this study to document pain scores 14

Many of the patients had multiple injuries, and so the VAS score was recorded during movement of the ribs i.e coughing and deep breathing. The pain scores were recorded before the SAPB and 60 minutes after by post-graduate residents who were not directly involved in administering the block . The VAS scoring system was used as it is the most commonly used simple method of pain assessment which utilizes a simple numeric scale from 0-10, 0 being no pain and 10 being the worst possible pain. It also has color to aid in the description of pain as green is no pain and red is worst possible pain helping those who communicate through colors and visual perceptions of pain, it also has happy face to sad or crying face to help assist those with language barriers or children.

The patients were then shifted to a block room and monitors were connected , intravenous fluid on flow.

Preparation

The patient was in a supine position, the arm abducted or in lateral position.

Drugs used- 1ml/kg body weight of 0.25% Bupivacaine with 8 mg (2ml) dexamethasone; In case of B/L fracture , volume not more than 40 ml of 0.25% Bupivacaine.

Equipment- Ultrasound machine with a high frequency 7-12hz transducer.

All blocks were done in a room where emergency equipments and drugs were available.

After positioning , the block area was sterilised and the probe was made sterile using transducer cover and sterile lubricant gel was used.

The authors trained in procedural ultrasound administered the blocks.

Technique

The transducer was placed in the mid-axillary line on the 5th rib. (By counting the ribs) in the sagittal plane using the technique suggested by Hadzik et al9. In this view, the latissimus dorsi (LDM) and the serratus anterior muscles(SAM) were identified as shown below.10,11

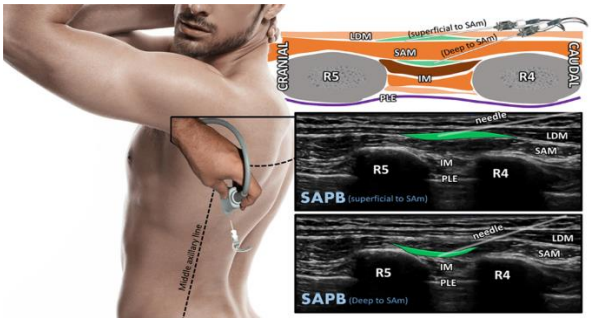


Figure 2: Ultrasound picture of the Serratus Anterior Block technique which was used in this study to administer the drug15

When there was a doubt about the plane , it was identified using the thoracodorsal artery using color doppler. The point of entry was anaesthetised using local anaesthetic 2% lignocaine to raise a wheal.

Using a 20 gauge cannula , the SA plane was entered using in-plane technique (cranial to caudal) with a high frequency transducer.

After hydro-dissection, the drug was slowly injected after regular aspiration (to rule out vascular puncture) into the SA plane with the vitals being closely monitored.

Below is an image of the drug after injection lifting off the serratus muscle and the latissimus dorsi as shown in the above picture (superficial to SAM)

The VAS was again recorded 60 minutes post block. Dynamic (Cough or deep breath) VAS less than or equal to 4 was taken as a successful block. Failure to relieve pain to at least 50 % of pre-block pain within 60 minutes was taken as block failure. Breakthrough pain or block failure was treated with IV Opioids.

Patients were kept in the observation room for 60 minutes post block to look for any signs of CVS/CNS signs of local anaesthetic systemic toxicity. The saturation and ET-CO2 (end-tidal CO2 levels) were recorded via pulse-oximetry and capnometry.

There were no patients who had any side effects.

The Patients were followed up for a period of 24 hours and the duration of block was recorded.

There were no patients whose condition deteriorated post block. Some patients who had hemopneumothorax were followed up for worsening. Overall the procedures were uneventful

III. Results

Table 1: shows demographics, number of rib fractures and pain scores before and 60 minutes after the block, also shows presence other injuries and co-existing lung diseases

Age/Sex	Site of MRF (Side/type & number of fractures)	Other Injuries	Pain score during movement: before block	Pain score during movement: after 60 min of SAP block	Duration of block in hours	Pre-existing lung disease
31 years/Male	L/ Double point 3rd,4th anterior rib #	Nil	9	2	14	No
52 years/Male	R/single point: 7th,8th,9th anterior rib #	R humerus #	10	3	12	Yes-Emphysema
42 years/Female	B/L - R/single point: 5th,6th anterior #; L/double point: 6th anterior #	B/L minimal Hemopneumothorax,	10	2	18	No
28 years/Male	L/ single point 2-5th posterior-lateral rib#	Nil	8	1	20	No
33 years /Male	R/single point 4-6th anterolateral #	L ankle #	9	2	11	No
62 years/Male	L/double point 6th,7th lateral #	Nil	7	2	18	Yes-COPD
19 years/Male	R/ single point 3rd ,4th rib# anterior	Nil	8	3	15	No
41 years/Female	R/ single point 4th-6th lateral #	R clavicle #	9	2	16	Yes-Bronchial Asthma
21 years/Male	L/single point 4th 5th anterior #; R/ single point 5th anterior #	L mild hemothorax	10	4	13	Yes-Bronchial Asthma
36 years /Male	R/single point 4-6th anterolateral #	Nil	7	3	15	No
58 years/Female	L/ double point 3-5th posterior rib#	Nil	8	2	12	No

Table above shows 15 patients we male and 5 patients were females. 8 patients had other injuries , among them 3 patients had chest wall, pleura, or lung injuries.

7 patients has pre-existing lung issues. 2 had COPD, 2 had Bronchial asthma and 1 had emphysema and 2 had reactive airways.

Descriptives

Table 2: Shows that the pain scores were significantly lower after 60 minutes of the SAP block

Descriptives

Descriptives

	Pain score during movement before block	Pain score during movement after 60 min of SAP block
N	20	20
Median	9.00	2.00
IQR	1.25	1.25
Minimum	7	1
Maximum	10	4

Table 2 :The median pain score before the block was 9 on the VAS scoring and 2 on the VAS score 60 minutes after the SAP block. These were dynamic pain scores i.e pain on coughing or deep breath. The The interquartile range is 1.25 for both which means that the reduction in the pain score can possibly be predicted , in other words we can expect a reduction of upto 60% of the pain after SAP block.

Table 3: 85% of patients VAS score of 8 or more before block

Frequencies

Frequencies of Pain score during movement before block

Pain score during movement before block	Counts	% of Total	Cumulative %
7	3	15.0 %	15.0 %
8	6	30.0 %	45.0 %
9	6	30.0 %	75.0 %
10	5	25.0 %	100.0 %

Table 3 shows that the majority of the patients had extreme pain with 85 percent of the patients reporting a pain scale above 8. Hence there is a need to address pain from multiple rib fractures seriously.

Table 4: Shows reduction upto 50% reduction in pain (VAS score) after block

Frequencies of Pain score during movement after 60 min of SAP block

Pain score during movement after 60 min of SAP block	Counts	% of Total	Cumulative %
1	5	25.0 %	25.0 %
2	9	45.0 %	70.0 %
3	4	20.0 %	90.0 %
4	2	10.0 %	100.0 %

The above table 4 represents the number of patients who have reported a VAS score of 1,2,3, and 4. 9 patients have reported a VAS score of 2 which means mild pain only and 5 patients have reported a VAS of 1 which is very little pain

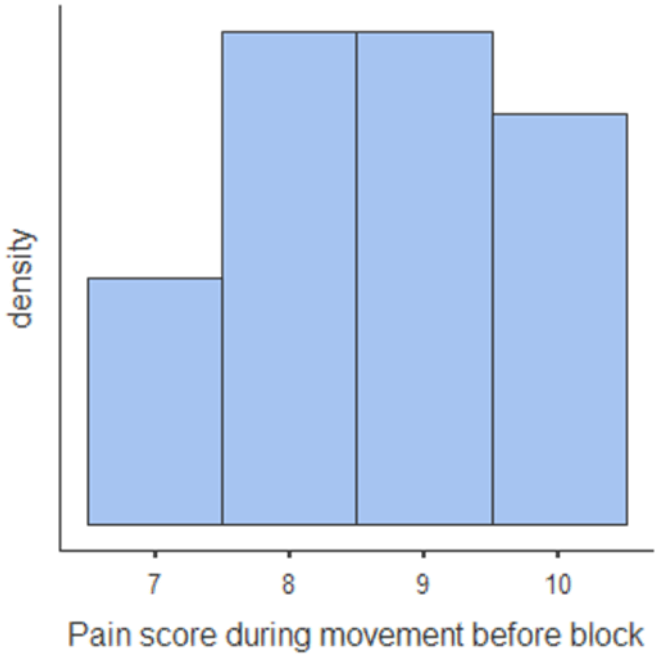
4 patients have reported a VAS score of 3 which means mild to moderate pain and 2 patients have reported a pain score of 4 which is moderate pain.

From this it can be concluded that there is a high patient satisfaction with 70 % of patients reporting very little to mild pain and 30 % reporting moderate pain.

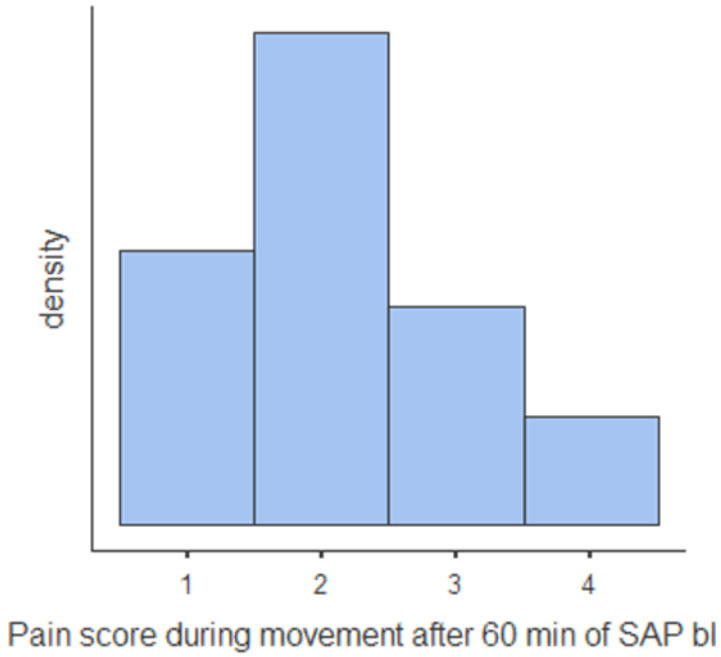
On the whole all patients has atleast 50% reduction in their pain scores.

Plots

Plot 1: Histogram representing density of VAS scores with majority reporting score of 8 and 9.



Plot 2-Histogram showing density of pain scores after 60 minute of block with majority reporting a score of 2, followed by 1,3 and 4.



The above plots 1 and 2 show that the patients with the higher VAS scores achieved higher pain relief as compared to the ones with lower pain scores. This is in accordance with the subjective quality of pain wherein the patient focuses more on the areas that hurt more and hence report higher relief/satisfaction when that area of pain is relieved.

IV. Discussion

Traditionally, MRF has been managed using multi-modal analgesia, including opioids, which may not always be advisable due to potential complications, particularly in patients with pre-existing pulmonary diseases. Thoracic epidural, while effective, may not always be feasible. SAPB emerges as a promising alternative, offering localized pain relief that can last up to 48 hours.

This study involved 20 patients with MRF who had persistent severe pain despite intravenous analgesia. The SAPB technique was administered, and pain scores were recorded before and after the block. Results showed a significant reduction in pain scores after 60 minutes of the SAPB, with a median pain score dropping from 9 to 2 on the Visual Analog Scale (VAS). The majority of patients reported either mild or no pain after the block, indicating high patient satisfaction. There were no reported adverse effects of the block, and patients were followed up for 24 hours post-procedure without any deterioration in their condition. There were 7 patients in whom pre-existing lung disease was present and they reported no difficulty in breathing and their saturation remained above 95 percent with no carbon dioxide retention as recorded with capnometry.

Furthermore, the study highlighted the duration of pain relief provided by SAPB, with the mean duration being around 15 hours. This demonstrates the potential for SAPB to offer prolonged pain relief in patients with MRF.

The findings suggest that SAPB can be a valuable tool in managing pain associated with MRF, offering effective pain relief with minimal risk and relatively easy administration. However, the study sample size is small, and further research with larger cohorts is warranted to validate these findings. Additionally, long-term outcomes and comparisons with other analgesic techniques would provide a more comprehensive understanding of SAPB's role in MRF management.

In conclusion, SAPB presents as a promising alternative for pain management in patients with MRF, offering effective and localized pain relief with minimal risk and potential for prolonged duration. Its simplicity of administration and favorable outcomes make it a valuable addition to the armamentarium of pain management strategies for MRF.

V. Summary

The study evaluates Ultrasound-guided Serratus Anterior Plane Block (SAPB) for managing pain in multiple rib fracture (MRF) patients. With 20 participants, SAPB significantly reduces pain scores post-procedure, with a median drop from 9 to 2 on the Visual Analog Scale (VAS). Most patients report mild or no pain after SAPB, suggesting high satisfaction. No adverse effects are observed, and SAPB provides around 15 hours of pain relief. This highlights SAPB's potential as an effective, safe, and easily administered method for MRF pain management, warranting further investigation and potential integration into clinical practice.

VI. Conclusion

Serratus anterior plane block shows promise as a safe, effective, and feasible method for managing pain in multiple rib fracture patients.

Conflict of Interest: None

Ethics Statement: The study was reviewed and given approval by ethics committee of Father Muller Charitable Institutions (number FMIEC/CCM/473/2023)

Consent: All Authors have given their consent for publication

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References

[1] Southgate Sj, Herbst Mk. Ultrasound Guided Serratus Anterior Blocks. Treasure Island, Fl: Statpearls Publishing; 2019. [Updated 2019 Mar 19]. Available From: Https://Www.Ncbi.Nlm.Nih.Gov/Books/Nbk538476/

[2] Bergeron E, Lavoie A, Clas D, Moore L, Ratte S, Tetreault S, Et Al. Elderly Trauma Patients With Rib Fractures Are At Greater Risk Of Death And Pneumonia. J Trauma. 2003;54:478–85.

[3] Ho Am, Karmakar Mk, Critchley La. Acute Pain Management Of Patients With Multiple Fractured Ribs: A Focus On Regional Techniques. Curr Opin Crit Care. 2011;17:323–7.

[4] May L, Hillermann C, Patil S. Rib Fracture Management. Bja Educ. 2015;16:26–32.

[5] Khemka R, Chakraborty A. Ultrasound-Guided Modified Serratus Anterior Plane Block For Perioperative Analgesia In Breast Oncoplastic Surgery: A Case Series. Indian J Anaesth. 2019;63:231–4.

[6] Madabushi R, Tewari S, Gautam Sk, Agarwal A, Agarwal A. Serratus Anterior Plane Block: A New Analgesic Technique For Post-Thoracotomy Pain. Pain Physician. 2015;18:E421–4.

[7] Blanco R, Parras T, Mcdonnell Jg, Prats-Galino A. Serratus Plane Block: A Novel Ultrasound-Guided Thoracic Wall Nerve Block. Anaesthesia. 2013;68:1107–13.

[8] Kunhabdulla Np, Agarwal A, Gaur A, Gautam Sk, Gupta R, Agarwal A. Serratus Anterior Plane Block For Multiple Rib Fractures. Pain Physician. 2014;17:E553–5.

[9] Hadzic

[10] Durant E, Dixon B, Luftig J, Mantuani D, Herring A. Ultrasound-Guided Serratus Plane Block For Ed Rib Fracture Pain Control. Am J Emerg Med. 2017;35:197e3.
[11] Camacho Fc, Segura-Grau E. Continuous Serratus Anterior Plane Block Provides Analgesia In Multiple Rib Fractures: A Case Report. Rev Bras Anestesiol. 2019;69:87–90.
[12] The Jamovi Project. Jamovi. (Version 2.4) [Computer Software]. 2023. Available From: Https://Www.Jamovi.Org.
[13] R Core Team. R: A Language And Environment For Statistical Computing. (Version 4.1) [Computer Software]. 2022. Available From: Https://Cran.R-Project.Org. (R Packages Retrieved From Cran Snapshot 2023-04-07).
[14] Figure 1: Vas Score (Visual Analogue Scale) That Was Used For The Assessment Of Pain.
[15] Figure 2:Serratus Anterior Block Technique -Shows The Sites Of The Injection That Is -Superficial To The Serratus Anterior Muscle And Deep To The Muscle.