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Case Report

Serratus anterior plane block as a bridge to outpatient management of severe rib fractures: a case report

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Rib fractures account for a significant number of emergency department visits each year. A patient's disposition often depends on the severity of rib fractures, comorbidities, and ability to achieve adequate analgesia. We present a 44-year-old male patient with severe pain secondary to rib fractures. The initial disposition was to admit for pain control. However, upon performing a serratus anterior plane block, patient was functionally appropriate for discharge with proper return precautions. Serratus anterior plane block is within the skillset of the emergency physician and can be used to achieve analgesia for rib fractures without the sedative and respiratory depressive effects associated with opioids.

Keywords Pain management; Emergency treatment; Nerve block; Rib fractures; Case report

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Capsule Summary

What is already known

It has been described in case reports that emergency physicians can perform the serratus anterior plane block with skill and efficacy for patients that are admitted for severe rib fractures. It is also well documented in anesthesia literature that this procedure may offer pain relief to postoperative patients who had undergone thoracic surgery.

What is new in the current study

There have been no case reports on performing this plane block in order to bridge a patient to appropriate and safe outpatient care. We have found an improvement to incentive spirometer scores and pain scores thirty minutes after administration of the plane block, as well as sustained improvement to both of these objective measures several days later on follow-up.

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INTRODUCTION

Each year an estimated 248,000 emergency department (ED) encounters and 46,000 hospital admissions occur in the United States due to a diagnosis of rib fracture.[1] Despite an estimated 12.9% decrease in overall traumatic injury rate in the ED, the rate of rib fractures has increased by 19%.[1] Approximately 13% of patients with at least one rib fracture experience complications which may include pneumonia, acute respiratory distress syndrome, pulmonary embolism, or empyema.[2] Advanced age and a total number of rib fractures are independent risk factors for increasing the complication rate.[3]

A principal goal in managing rib fractures, the pain of which often impedes deep inspiration, is to provide analgesia without further contributing to atelectasis by depressing respiration or increasing airway obstruction.[4] Although opioids can act as effective analgesics, they also suppress ventilatory drive and can cause excess sedation, which is counterproductive in the context of treating rib fractures.[5] Agents such as nonsteroidal anti-inflammatory drugs and ketamine have been found to decrease opioid requirement in patients with rib fractures,[6,7] but are short-acting and contraindicated in certain patient populations. Thoracic epidurals are a common interventional technique to treat rib fracture pain. However, a recent matched analysis of 1,360 patients found no mortality benefit and significantly higher rates of respiratory complications such as pneumonia, respiratory failure, and pulmonary embolism.[8] Furthermore, epidurals are largely out of an emergency physician's scope of practice, and recommending one requires inpatient hospital admission for epidural placement and management, which may not be the ideal disposition for an otherwise healthy patient presenting with rib fractures.

Recently, there have been a number of studies described in the anesthesia literature describing the efficacy of ultrasound guided serratus anterior plane blocks (SAPBs) prior to thoracoscopic surgery.[9,10] The plane between the serratus anterior and latissimus dorsi muscles houses the intercostobrachialis nerve, lateral cutaneous branches of the intercostal nerves, long thoracic nerve, and thoracodorsal nerve.[11] The goal of local anesthetic administration into this plane is to provide analgesia across a unilateral T3-T9 dermatomal distribution.

CASE REPORT

A 44-year-old previously healthy male patient presents to the ED with 5 days of severe, right sided chest wall pain. He stated that approximately 5 days ago, he was involved in a motorcycle accident, and sustained multiple right sided rib fractures and was hospitalized at an outside hospital and discharged yesterday. He then came to our ED with worsening chest wall pain that was exacerbated with deep breaths. He had difficulty ambulating and repositioning in bed secondary to his chest wall pain. He had tried taking oxycodone-acetaminophen 5 to 325 mg at an unknown frequency at home without relief.

When asked about his hospital course and follow up plan, he stated that he could not recall due to a significant number of medications administered for pain that caused drowsiness during his entire hospitalization. The patient was unsure if he had surgery performed and could not recall the exact number of days he was hospitalized.

On examination, he was tachypneic to 27 breaths/min and saturating 94% on room air. The rest of his vital signs were within normal limits. The patient was in severe pain especially upon repositioning. Physical exam was notable for tachypnea, shallow breaths, and decreased breath sounds bilaterally, without any wheezes, rales or rhonchi. Significant ecchymosis was noted to his right superior axilla, his right flank, and right buttock. Two lateral incisions on his right chest wall were noted to be well-approximated without signs of infection or surrounding crepitus. However, the patient was exquisitely tender to palpation in this distribution. An eFAST (extended focused assessment with sonography for trauma) was performed and was negative for any acute findings.

A chest X-ray was performed which revealed low lung volumes bilaterally, left greater than right bibasilar atelectasis, right lateral chest wall subcutaneous emphysema, and right sided rib fixation

Fig. 1. Anterior-posterior chest X-ray depicting lung volumes bilaterally with bibasilar atelectasis. Also noted is right lateral chest wall subcutaneous emphysema and right sided rib fixation hardware.

Fig. 2. A three-dimensional reconstruction from a computed tomography angiography of the chest demonstrating eight rib fractures and rib fixation hardware.

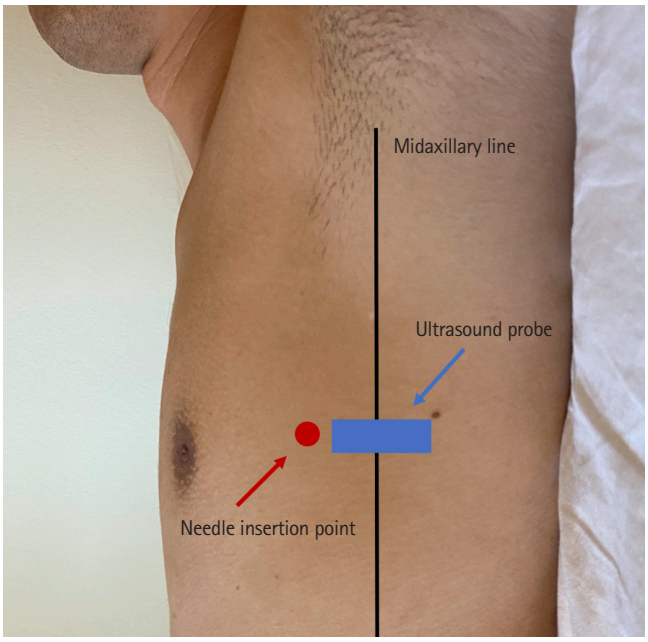

Fig. 3. Model demonstration with a supine model. Ultrasound probe to be placed (blue) in the transverse orientation at the midaxillary line and the level of the fourth or fifth rib. Needle insertion (red) at the anterior axillary line. Written informed consent for publication of the clinical images was obtained from the patient.

hardware (Fig. 1). A three-dimensional reconstruction from a computed tomography angiography of the chest was performed (Fig. 2) given the patient had a number of risk factors and symptoms concerning for pulmonary embolism such as his pleuritic chest pain, his recent trauma, recent surgery, and decreased ambulatory status.

The computed tomography angiography chest was negative for pulmonary embolism, however showed mild bibasilar dependent atelectasis and trace pneumothorax on the right side. These imaging studies demonstrated a total of eight rib fractures including the lateral third rib, the anterior and posterior third through sixth ribs, the posterior seventh rib, and the lateral eighth rib. The patient also had rib plating hardware noted on the lateral right fourth through seventh ribs. Furthermore, the patient also had a nondisplaced fracture of the inferior right scapula.

The patient initially received two separate doses of 4 mg intravenous (IV) morphine with little to no relief to his pain. His incentive spirometry was measured at 1,200 cc with significant pain. At the time, he was not amenable to discharge as his pain had not been relieved with oral medications at home, and now IV medications in the ED. The patient was offered and consented for a SAPB. The block was performed using sterile technique and under ultrasound guidance using a high-frequency linear transducer. Twenty minutes after the procedure, the patient noted a significant improvement in his pain level, and was now able to perform 1,500 cc at best effort in incentive spirometry, as compared to 1,200 cc prior to his plane block. At this time, the patient was agreeable to discharge, and was given instruction on multimodal pain therapy and prescribed lidocaine 5% patches, methocarbamol, and hydrocodone-acetaminophen 5 to 325 mg tablets for break through pain. The patient was also instructed to take ibuprofen and acetaminophen scheduled, and to continue with IS every hour while awake at home.

After 2 days, the patient was contacted for a follow-up. He reported that his SAPB relief lasted roughly 24 to 36 hours. He was then able to take additional doses of his oral pain medications. His incentive spirometry score was improved to 2,000 cc, a significant improvement from 1,200 cc at presentation to our ED. The patient was able to recall all of the events during his ED visit, along with the discharge plan that was previously discussed with him. He was significantly less sedated, able to increase his activity level, and was optimistic regarding his recovery. The patient provided written informed consent for publication of the research details and clinical images.

DISCUSSION

To perform this technique you will require an ultrasound with a high frequency linear transducer, 20 to 30 cc of bupivacaine 0.25% (maximum 2 mg/kg), 5 to 10 cc of 1% lidocaine without epinephrine, 20- to 22-gauge spinal needle, extension IV tubing, 3-way stopcock, 27-gauge needle, 30-cc syringe, 5- to 10-cc syringe,

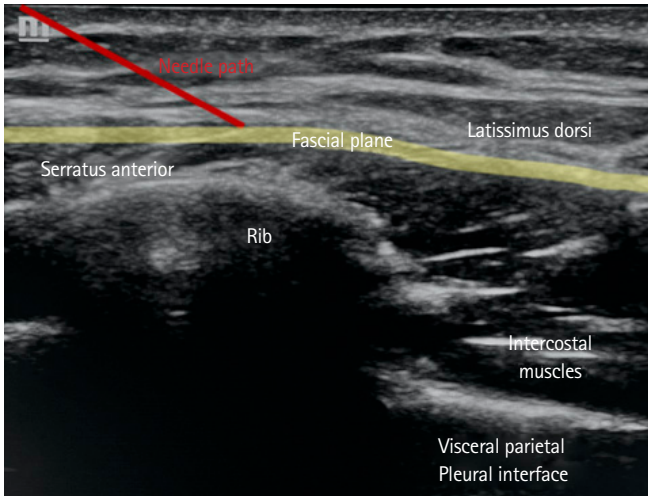

Fig. 4. Ultrasound images in the transverse view at the midaxillary line. The target is the fascial plane (yellow) in between the latissimus dorsi muscle and serratus anterior muscle. Needle path (red) should be at a 30° to 60° angle from the skin. For orientation purposes the intercostal muscles, rib, and visceral parietal pleural interfaces have been noted in the figure.

and a normal saline flush. The ultrasound probe will be placed on the patient in the transverse orientation at the midaxillary line as seen in Fig. 3. Relevant anatomy should be identified as seen in Fig. 4, with the target of injection being the fascial plane superior to the serratus anterior muscle. Once the anatomy is identified, patient should be marked, and cleansed with antiseptic cleaning solution.

Using a 27-gauge needle and 5- to 10-cc syringe, make a skin wheal at the needle insertion site and then under ultrasound guidance, infiltrate local anesthetic along the anticipated tract in which you will insert your spinal needle. Once complete, attach your spinal needle to the IV extension tubing, and then to a 3-way stopcock to the opposite end. On the other two ends of the 3-way stopcock, attach your 30-cc syringe filled with bupivacaine and your normal saline flush. Insert your spinal needle at your skin wheal at a 30° to 60° angle. In the longitudinal view under ultrasound guidance, advance your needle until you approach the fascial plane just superior to the serratus anterior muscle. The entire needle, and most importantly the tip of the needle, should be visualized with ultrasound prior to any needle advancement to best avoid pleural puncture. Once at the appropriate location, as indicated in yellow in Fig. 4, and after negative aspiration, inject 1 to 2 cc of normal saline until you visualize the appropriate separation of fascial planes. If you do not witness the spread of fascial planes, readjust your needle and once again inject with normal saline to confirm your location. Once confirmed, inject your bupivacaine solution and then flush the extension tubing with your normal saline.

In this case report, one factor that may have led to the patient's lack of pain control in the outpatient setting was his inability to recall not only the events of his hospitalization but also his discharge instructions. Although it is unclear what medications he received at the outside hospital, opioid analgesics can commonly result in over sedation and may have contributed to this patient's confusion with discharge instructions. Parenteral opioids can result in successful analgesia, however they can also contribute to excess sedation and are short-acting. The SAPB allows providers to offer patients longer lasting analgesia upon discharge without excess sedation.

Prior to performing the SAPB, the patient had received two doses of morphine 4 mg IV in our ED with little to no relief. There was concern that the patient might require admission for pain control, however given there was pain relief and improvement in his incentive spirometry volumes after the SAPB, patient and ED team agreed he was appropriate for discharge home with appropriate return precautions. His improved functional status on follow-up phone call added further credence to incorporation of SAPB as a bridging strategy for patients from the ED to the outpatient setting when combined with multimodal oral analgesics. Further studies in the form of randomized controlled trials may be warranted to determine if there is a significant reduction in pulmonary complications and opioid use after a SAPB performed in the ED for traumatic rib fractures.

This case study illustrates the feasibility of SAPB as an analgesic strategy for rib fracture pain in the ED. Although training in procedure performance may not be standard across residency programs, the Accreditation Council for Graduate Medical Education has included use of ultrasound for procedural guidance as one of the core milestones of the emergency medicine resident.[12] With a strong base in procedural skills using ultrasound guidance for common ED procedures such as central line placement, paracentesis, and diagnostic testing, it is arguably within the skill set of the emergency physician to perform the SAPB.

In our case report, SAPB provided this patient with analgesia that was less sedating and longer acting than a single administration of opioid analgesic. We believe the SAPB may be a reasonable intervention by which the emergency physician may bridge a patient to outpatient pain management of rib fractures when combined with multimodal therapy. Further studies in the form of randomized controlled studies may help to determine important benefits or consequences of this technique such as the rate of complications, rate of admission versus discharge, and overall effectiveness of pain control after SABP performed in the ED setting.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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