Chapter

Pain Management in the Emergency Department- Newer Modalities and Current Perspective

Sakshi Yadav, Anuj Ajayababu, Tej Prakash Sinha and Sanjeev Bhoi

Abstract

Pain is one of the most common complaints and yet one of the most neglected aspects of management in the emergency department. Optimal pain management is a nuanced skill which focusses on reduction of pain to an acceptable level to allow for safe discharge and return to normal activities, in addition to improving patient satisfaction and comfort during their stay in hospital. Adequate analgesia also improves physiological parameters such as heart rate and blood pressure. The aim is improving rather than eradication of pain altogether while maintaining an acceptable level of adverse effects. This chapter will discuss assessment of pain in the emergency department along with various modalities of pain management with specific focus on newer modalities including ultrasound guided regional nerve blocks. Ultrasound guided nerve blocks are associated with better analgesia and have fewer chances of drug related adverse events, especially in older patients and those with comorbidities where large doses of systemic medications are associated with a significant risk of adverse effects.

Keywords: pain management, emergency department, pain score, nerve blocks, USG guided

1. Introduction

Pain is one of the most common complaint of patients presenting to the Emergency Department (ED), with the frequency of severe pain reported anywhere between 20% and 40% worldwide [1]. Regardless, pain management in ED is often delayed due to overcrowded emergency rooms (ER) [2, 3] or poorly treated (oligo-analgesia) due to improper analgesic dosing [4–6]. Pain management in the ED can be used as an indicator of quality care [7–11]. Studies have shown that patients want to be treated for their pain in less than half an hour, yet the normal duration of treatment is at least 78 minutes [12]. The primary goal of acute pain management is not complete relief from pain, but reduced pain to an acceptable level that will allow for safe discharge by returning to daily patient activities in addition to improving patient comfort while in hospital. Uncontrolled pain can contribute

to the development of comorbidities such as depression, high blood pressure, and immune system deficiency [13]. The type of treatment should be chosen and managed in such a way that with the reduction of pain in the patient, the analgesia method should have as few side effects as possible. The most widely used analgesics, both in ED and during discharge are acetaminophen (alone or in combination with hydrocodone), ketorolac, and ibuprofen [14]. Neuraxial analgesia is increasingly becoming an integral part of emergency management of various clinical situations and emerging emergency physicians need behavioral training. As a practice, they provide better long-term analgesia with reduced side effects at the hands of trained emergency care physicians.

2. Pain assessment

The intensity of the patient's pain is not always obvious. Facial expressions and behavior may give some clues but they are unreliable. Number of dosages or tools available to patients to indicate the severity of their pain, response to analgesic agents, or both. Using a pain screening tool directs the selection of analgesic agents and provides an indication of the patient's pain response.

2.1 Verbal descriptor scale

These are quick and easily implemented and particularly appropriate for older patients. In descriptive scales, we simply ask the patient to estimate their pain [15]. Choose from (**Figure 1**).

2.2 Numerical and combined rating scales

They offer a wide range of choices and avoid vague descriptive words. They need more concentration and communication. Good visual acuity is required for the visual analogue scale [18]. These include:

a. Visual analog scales

b. Verbal numerical rating scale

c. Combined verbal and numerical rating scales

2.2.1 Visual analog scales

The visual dimensions of the analogue are 100 mm lines with verbal anchors. Patients may be asked to mark their pain or relief of pain in a horizontal line depending on how severe or how much relief occurs in treatment (**Figures 2** and **3**).

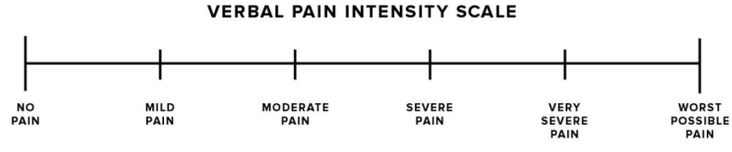

Figure 1.
Verbal descriptor scale. From references [16, 17].

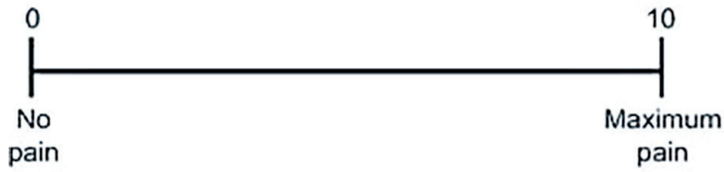

Figure 2.
Visual analogue scale for pain assessment.

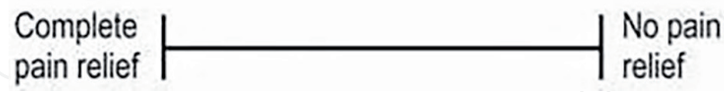

Figure 3.
Visual analogue scale for analgesia testing.

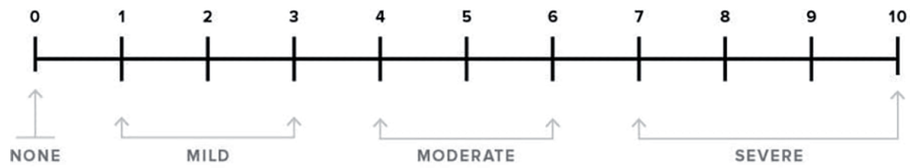

Figure 4.
Verbal numerical rating scale.

2.2.2 Verbal numerical rating scale

Patients should score their pain scores on a scale from 0 to 10, where 0 is painless and 10 is the most severe pain imaginable (**Figure 4**).

2.2.3 Combined verbal and numerical scale

Patients have further descriptive meanings in addition to numerical points to guide them in calculating pain (**Figure 5**).

One of the most commonly used standardized pain measurements is the Defense and Veterans Pain Rating Scale (DVPRS) (**Figure 6**) which has been validated in a variety of hospital and patient settings and is one of the most commonly used pain measurements in emergency departments. Uses improved numerical range of active word dictionaries, color coding, and graphic facial expressions matched by pain levels [16].

3. Principles of pain management

There are a number of pain management principles to keep in mind when choosing an analgesic agent. The WHO Analgesic Ladder has been the most frequently cited topic for decades and has five themes that guide our choices [19].

a. Oral administration is preferred whenever possible

b. Analgesics should be given regularly enough to maintain pain control

c. Agents should be selected based on the magnitude of the reported pain

Figure 5.
Verbal and numerical measurements.

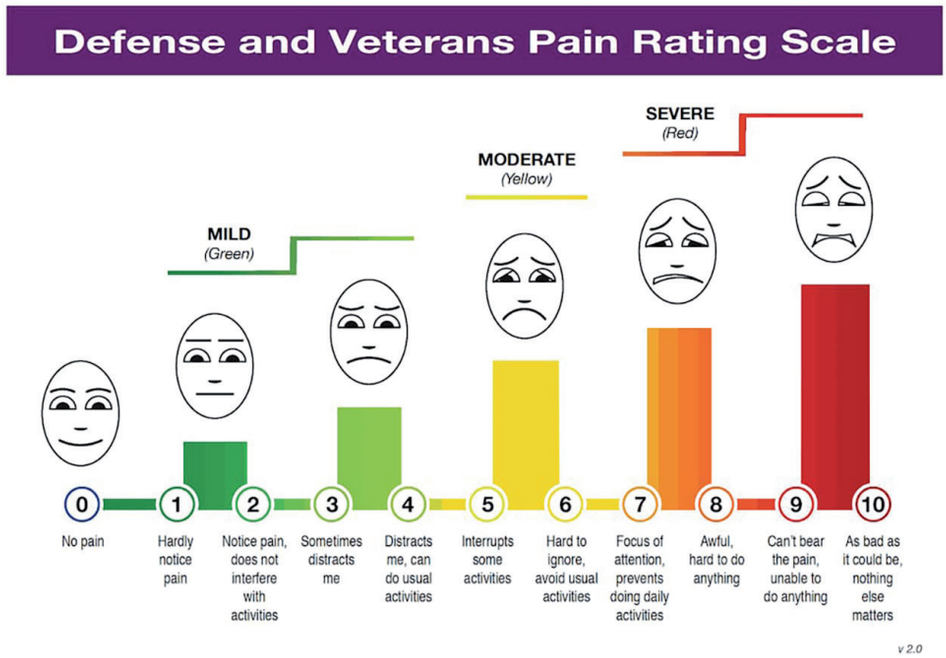

Figure 6.
DVPRS Defense and veteran pain rating scale.

d.The dose of agents should be appropriate for the patient

e. Patients should be given clear instructions on how/when to take their medication

4. Common analgesics used in ED

Non-opioid analgesics include acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDs), and cyclooxygenase 2 (COX-2) inhibitors. NSAIDs and COX 2 inhibitors have anti-inflammatory properties.

4.1 Acetaminophen

Acetaminophen is usually a first-line agent in ED for minor pain. This is due to the effective treatment of low grade pain and the little side effects that come with it. Its mechanism of action is inhibition of prostaglandin endoperoxide H2 synthase and cyclooxygenase activity [20]. Its central antipyretic effect is widely used when fever

needs to be reduced. Unlike NSAIDs, Acetaminophen does not fight inflammation and therefore its use is limited to non-inflammatory conditions only. Studies have shown that injected acetaminophen can have similar analgesic effects to injectable NSAIDs in ED, as well as morphine in other painful processes [21–24]. It has also been shown that the addition of paracetamol to NSAIDs increases the effect of analgesia compared with NSAID use alone [25].

4.2 NSAIDs

NSAIDs reduce pain by preventing prostaglandin synthesis involved in both acute and chronic painful conditions [26]. The synergistic combination of 400 mg ibuprofen and 1000 mg paracetamol (acetaminophen) is an early example of moderate analgesia and has long been considered the first analgesic drug for mild to moderate pain [27, 28]. The reduction in pain by this compound has analgesic activity almost similar with oral opioid compounds (oxycodone/hydrocodone-acetaminophen) used in the treatment of acute musculoskeletal pain [29]. NSAIDs are best for inflammatory pain associated with prostaglandins such as renal colic and menstrual pain [30]. Lack of respiratory depression, lack of dependence, and long-term relief effect are some of the most important benefits of NSAIDs compared to injectable opioids. The main side effects of NSAIDs include intestinal obstruction, kidney failure, platelet obstruction, cardiovascular effects and anaphylaxis. Kidney failure is caused by decreased prostaglandin production, which contributes to afferent glomerular arteriole vasodilation. NSAIDs contribute to arteriolar vasoconstriction, leading to a decrease in renal pressure and a decrease in glomerular filtration levels [31]. This is made worse by dehydration. The most common side effect of NSAIDs is gastrointestinal injury, such as bleeding or dyspepsia and gastric ulcer. Patients at high risk for peptic ulcer or its complications, such as the elderly, those with bleeding diathesis, or patients taking glucocorticoids, have objections related to NSAID use. In addition, it has also been shown that certain COX 2 inhibitors may promote heart failure associated with kidney function by causing sodium retention. There is no guaranteed efficacy of one type of NSAID over another, including administration route [32–34].

4.3 Ketamine

For decades, ketamine has been used in the ED for procedural sedation but is now gaining attention as a potential alternative to opioids because of its unique analgesic effect. It is an effective N-methyl-d-aspartate (NMDA) receptor antagonist that provides safe and effective analgesia in subdissociative doses 0.1–0.3 mg/kg IV or less while maintaining respiratory and cardiopulmonary stability in an emergency [35, 36]. Side effects of ketamine include nausea, stomach upset, tremors, dizziness, and nystagmus (detected immediately after onset of action) [36]. These effects are increasingly evident among older patients where sub-dissociative doses should be used with caution. Infusing ketamine over 15 min (as opposed to IV push) reduces these side effects. Co-administration of prophylactic ondansetron and midazolam may be used to treat post-ketamine nausea and the onset of consecutive reactions [37].

4.4 Opioid medications

Opioids have been the gold standard for pain management in cancer patients for a long time. Its use has now been increased nearly 10 times in patients without cancer as

well. They work on one of the three main opioid receptor systems (mu, kappa, delta). They can have analgesic and depressant effects on the central nervous system (CNS). Most opioids used in the clinic target μ-opioid (mu) receptors. These receptors mediate analgesia as well as common side effects such as nausea, constipation, and respiratory depression. Within the gastrointestinal system, opioids cause constipation [32]. However, Opioid prescription in ED serves as major factor for long term opioid usage and hence limiting its use. In 2019, an average of 38 people died each day from overdoses involving prescription opioids, totaling more than 14,000 deaths [38]. While prescription opioids were involved in over 28% of all opioid overdose deaths in 2019, there was a nearly 7% decrease in prescription opioid-involved death rates from 2018 to 2019 [39].

4.4.1 Morphine

It is one of the most widely used opioids in ED. Side effects ranges from hypotension, pruritus, nausea, vomiting, and respiratory depression. Respiratory depression is caused by medullary desensitization of carbon dioxide, with opioids binding to mu receptors. Cardiovascular effects are mediated directly through the sinoatrial node. A person should start with a recommended dose of 0.1 mg/kg if side effects are severe; However, rebolus with same dose can be given if the pain is not relieved in next 5–15 minutes. The study also found that obese patients do not need extra morphine and that, indeed, weight-based dosage is not really necessary [40, 41]. Widely used for dyspnea, especially in cancer patients and palliative care, nebulized morphine has also been found to be effective in cases of severe pain and difficult IV access (e.g., critical lung disease in sickle cell patients) [42].

4.4.2 Fentanyl

Fentanyl is 100 times more potent than morphine which allows for faster onset and shorter duration if needed in order to reduce titration faster in chronic severe pain compared to traditional analgesics. Its initial duration is 1–2 minutes and usually lasts about 30 minutes [20]. The initial IV dose is 1.5 μg/kg, and has the advantage of a short half-life. Fentanyl causes a slight release of histamine, making it ideal for patients with high blood pressure. It can also be given orally as a lollipop or intranasal or by nebulisation. Compared with morphine and hydromorphone, which is converted by the liver to active metabolites that require renal clearance, fentanyl is digested by the liver into inactive metabolites that are safer in patients with renal failure [43].

4.4.3 Tramadol

Tramadol is partial mu-opioid receptor agonist that doubles as a serotonin and norepinephrine reuptake inhibitor (SNRI) [44]. The analgesic effect showed that it was less than a combination of 500 mg acetaminophen and 5 mg hydrocodone for severe muscle and bone pain [45], no more than 1 mg/kg IV diclofenac for extremity injury limit [46], and no more than 5–10 mg IV morphine for organ pain [47]. Tramadol abuse has been shown to be a major component of ED visits [48]. It can cause nausea, tachycardia, convulsions, confusion, high blood pressure, hypoglycemia, and low consciousness [49].

5. Peripheral nerves

Peripheral nerve blocks prevent the need for process sedation and provide adequate anesthesia during painful procedures. This procedure can be performed in the emergency department with the help of ultrasound imaging to identify targeted sensors [50]. The ability to manage peripheral nerve blocks in ED has the potential to provide faster and more accurate analgesia with less systemic side effects compared to parent drugs. The effectiveness and duration of block time depends on the pharmacology of the analgesic/anesthetic agent used, dosage, and concentration. In peripheral nerve block, the purpose is to place a local anesthetic near the nerve because of which there is always a growing chance of nerve damage. However, most neurological injuries are temporary, with most patients recovering within 3 weeks. Ultrasound and nerve stimulator techniques have been shown to reduce complications from peripheral nerve blocks. Prior to the decision to perform a peripheral nerve block, a careful medical history should be obtained including allergies, anticoagulants use, pre-existing nerve damage, active site-specific diseases, and the ability to cooperate with procedures.

5.1 Femoral nerve block

Commonly used to anesthetize the hip, front thigh and knee. The femoral nerves exit the lumbar plexus and the subjects near the psoas muscle, before passing down the lateral inguinal muscle to the femoral artery within the femoral triangle. The fascia iliaca lies deep in the fascia lata, and separates the femoral nerve from the femoral artery [51, 52]. The patient is placed in supine position with the affected extremity in abduction and external rotation, as tolerated. The high-frequency linear probe is used to visualize the femoral nerve and artery by placing the probe in the inguinal crease, corresponding to the inguinal muscle, and the probe mark to the right of the patient (**Figure 7**). The nerve is hyperechoic, usually oval or triangular shape, and is located approximately 2–6 cm below the skin. Using a sterile method, insert a long needle into the plane at the edges of the probe, directing the space behind the sensor. One will often feel "the give away feel" as the tip of the needle exceeds the resistance of the iliac fascia. Once the tip of the needle is positioned, inject 1–2 mL of local anesthetic to ensure the placement of the tip of needle. Proper placement is confirmed by seeing a local anesthetic around the nerve, which improves its visibility on the ultrasound monitor. Once the correct placement has been confirmed, 10–20 ml of the selected anesthetic is injected. It may take 10–20 minutes to work [52, 53].

5.2 Fascia iliaca block

This block was originally used for hip and knee surgery and analgesia following hip or knee procedures is increasingly being used as part of pain management for fractures including hip and femoral neck and shaft fractures. In this process the femoral artery is first visualized by placing the transducer opposite to the inguinal crease, followed by a gradual lateral or medial movement. Tilt the probe to detect the hyperechoic fascia iliaca on the surface of the hypoechoic iliopsoas muscle. Medially, the femoral nerve appears deep in the fascia and lateral to artery. Laterally, the sartorius muscle is identified by its normal triangular shape when pressed by a transducer. The tip of the needle is placed under the fascia iliaca about one-third of the posterior

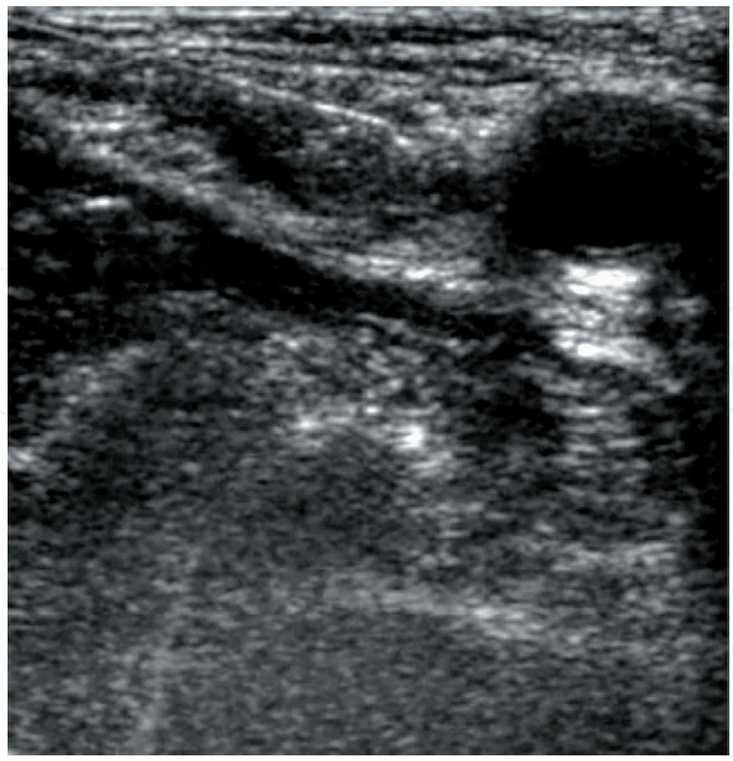

Figure 7.
Femoral nerve block.

line connecting the anterior iliac spine to the pubic tubercle (injection is performed several inches along the femoral artery). As the needle eventually pierces the fascia, one may feel loss of resistance, and the fascia may appear to "repeat" backwards in the US image. After negative aspirations, 1–2 mL of local anesthetic is injected to ensure proper injection plane between the fascia and iliopsoas muscle. A relatively large dose (20–40 mL) of local anesthesia is injected until it is spread along the iliac spine and femoral vein. Proper injection will result in splitting the fascia iliaca with a local anesthetic in the center from the injection site.

5.3 PENG block

Latest literature has described the nerve supply of the anterior capsule of the hip joint as the obturator nerve, accessory obturator nerve, and femoral nerve. These studies also examined the relationship between these nerves and other symptoms of soft or soft tissue that are detected by ultrasound guidance [54]. Studies have shown histologically that the anterior capsule has multiple nociceptive fibers, while the posterior capsule is primarily composed of mechanoreceptors [55]. The pericapsular nerve group (PENG) block is introduced to direct and block these articular branches that provide stability within the hip. This regional anesthetic was described in 2018 by Giron-Arango et al. [56]. In this case, the ultrasound probe is placed in a flexible plane over the anterior iliac crest (AIIS) and proceeds upwards to visualize the pubic ramus. The femoral artery and ilio-pubic eminence (IPE) are then visualized. Using in plane procedure the needle was developed from side to side, and 20–25 ml local anesthetic of 0.5% ropivacaine was inserted between the psoas tendon in the front and the pubic ramus in the back. As this blocks the accessory obturator nerve, theoretically provides better analgesia compared to the fascia iliaca block.

5.4 Brachial plexus block

It is used to help reduce fractures of the upper extremities and even reduce shoulder dislocations. There are two basic methods of Brachial plexus block - Interscalene and Supraclavicular. The Interscalene block is not used for the procedure below the elbow.

5.4.1 Interscalene block

The patient is placed on the supine, with the head turned away from the affected side. The probe is placed almost in the middle of the neck, in line with the clavicle. After identifying the common carotid artery and internal jugular vein, the probe slides sideways to detect the frontal and medial scalene muscles. The roots of the brachial plexus emerge between these two muscles as three different nerve bonds in this area. Next, aspiration is performed to rule out the vascular perforation, and the placement is confirmed by the anesthetic injection. Depending on the agent used, the local anesthetic dose can be 15–45 ml.

5.4.2 Supraclavicular block

The patient is placed supine and the head is turned away from the side of interest. The probe is placed at the base of the neck in the supraclavicular groove, which corresponds to the clavicle. The subclavian artery is identified and lateral to subclavian hypoechoic trunks of the brachial plexus can be seen. The 27 gauge needle is then used to inject into the skin with 1–2 ml of local anesthetic just along the canal. The block needle, 22-gauge, is then advanced in a plane toward the brachial plexus from laterally to medially.

Sometimes a person may experience "the give away feeling" when the brachial sheath is inserted. The person then wishes to confirm intravenous infusion and inject 1–2 ml of anesthetic to check the brachial plexus. Next, about 20–25 ml of anesthesia is injected, until a sufficient spread around the brachial plexus appears. Proximity of the artery and pleura carries a real risk of injury to these vital structures.

5.5 Erector spinae plane block (ESPB)

Pancreatitis is the most common gastrointestinal complaint that needs to be admitted to the emergency department (ED). The most common complaint of pancreatitis is severe abdominal pain. The T7 vertebrae is identified by counting from C7, the most prominent cervical vertebrae. Place the linear probe on the parasagittal plane, 3 cm lateral to T7 vertebral level to see the dynamic process. The erector spinae fascia appears just next to the flexible process. The needle is inserted between the flexible process and the erector spinae fascia and approximately 30 ml of local anesthetic is injected [57]. ESPB may be used for rib fractures, lumbar fractures, post herpetic neuralgia, back pain and renal colic (**Figure 8**) [58].

5.5.1 Injuries to the chest wall and nerve blocks

Broken ribs are common not only in patients with chest injuries but also common in patients with polytrauma. It is the cause of significant illness and death in such patients and adequate analgesia is very important in improving impaired ventilatory function, preventing atelectasis, and reducing the need for mechanical ventilation

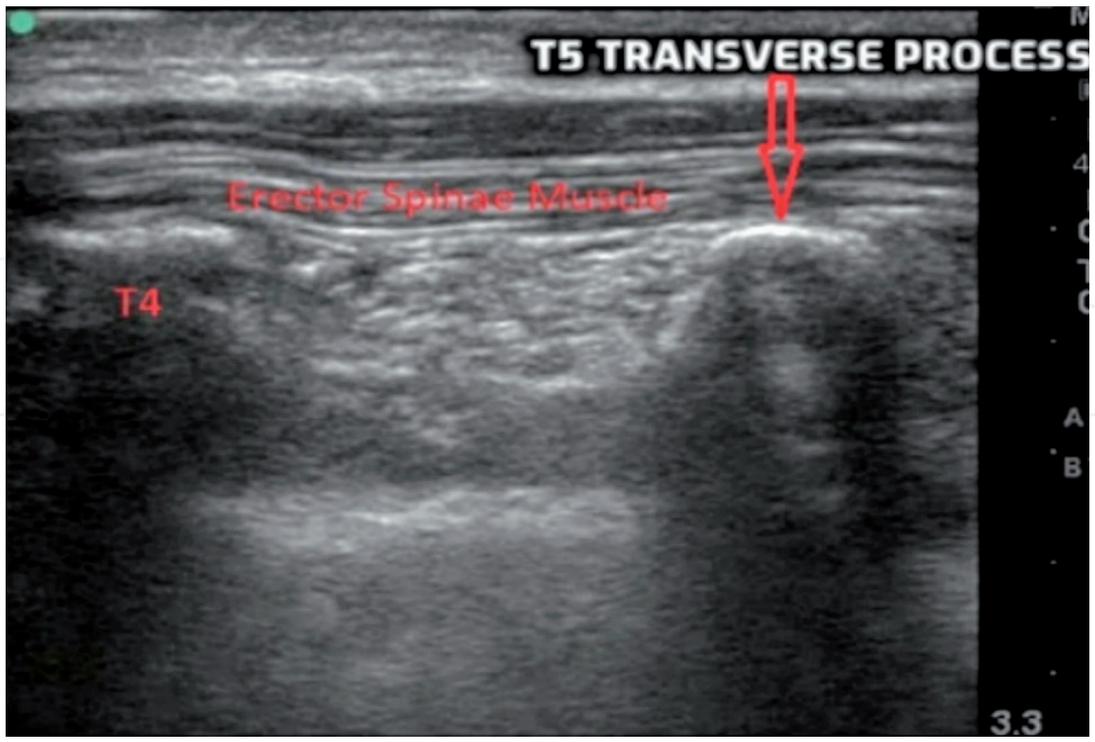

Figure 8.
Erector spinae block.

and associated diseases, in addition to improving patient outcomes and patient comfort. Opioids which are the mainstay of treatment in such patients have a variety of side effects including respiratory depression, coughing, and delirium. Nerve blocks develop into a critical component of emergency management of such injuries leading to better patient outcomes and patient satisfaction with analgesia. The Erector spinae block has already been shown to be effective in terms of analgesia for fractures of the posterior ribs and fractures of transverse processes of the vertebrae as shown by previous studies involving authors in this book [59].

5.6 Serratus anterior plane block

Serratus anterior plane block is increasingly becoming part of the clinical practice of treating patients with multiple rib fractures in the ED. Its efficacy, easy procedure and single-injection method in supine position with limited side effect has made it more popular in polytrauma patients with rib fractures. In a study published by the authors [60], a method within the serratus anterior plane block was used. In this case, the probe was placed in the sagittal plane, and the 5th rib in the medial axillary line appeared first. The Latissimus dorsi and the serratus anterior muscles are identified by over 5th ribs. The plane between the two muscles was further confirmed by identifying thoraco dorsal vein using color doppler. A small induration is made in the area marked with the injection of 1% lignocaine and adrenaline. A gap of 3–5 min is allowed to confirm the onset of skin anesthesia after which bupivacaine (0.5% at a dose of 1 mg/kg body weight and diluted with an equal volume of NS to make a solution of 0.25% while not exceeding the total volume 40 ml) injection using a 50 mm 18 g catheter needle using in plane method from superior anterior to posterior inferior for proper absorption. Once the plane between the serratus anterior and the latissimus dorsi is reached (**Figure 7**), rule out any vascular injury. Initially, 2–3 ml of LA is

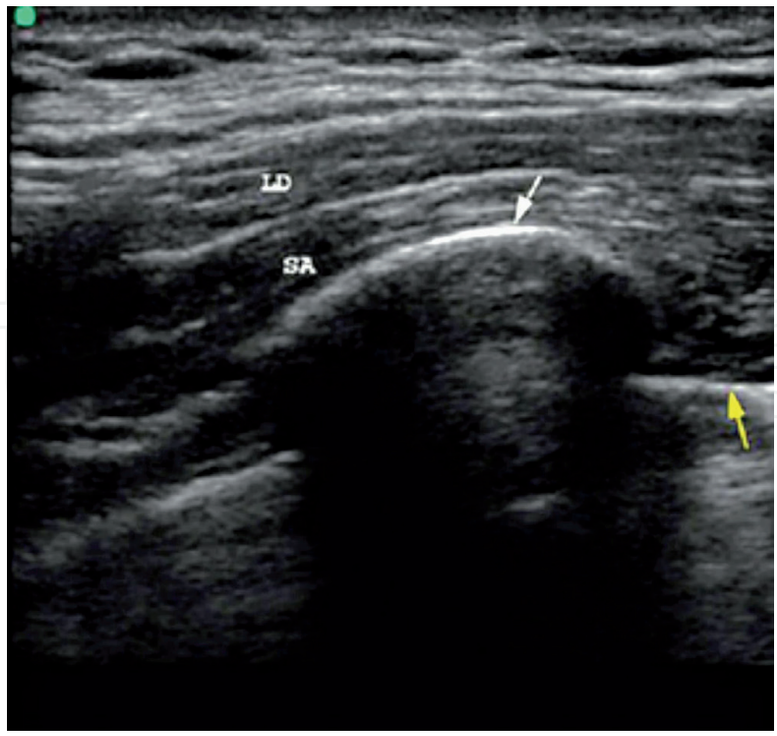

Figure 9.
Serratus anterior plane block. SA serratus anterior, LD latissimus dorsi.

injected to confirm hydro dissection between the latissimus dorsi and serratus muscle visible on ultrasound. The remaining solution is given gradually under continuous ultrasound guidance (**Figure 9**).

5.7 Pecs block

Both pecs I and Pec II block are widely used for fractures of the anterior ribs in patients with chest trauma. In pecs I nerve block, the plane between the major and minor pectoralis is hydrodissected to block the private and middle cutaneous nerves.

Pecs I nerve block involves the hydro separation of the plane between the pectoral muscles with local anesthetic to the lateral and the medial pectoral nerves. First, the major and minor pectoralis and pectoral branch of the thoraco-acromial artery are detected using ultrasound guidance. The lower border of the probe is rotated slightly to the side to visualize the pectoral branch of the thoraco-acromial artery and using the local anesthetic method is injected after initial confirmation using hydro-dissection of the space between the two pectoral muscles.

In the Pecs II nerve block, infiltrate the two fascial segments (pectoral and clavipectoral) by separating the local anesthetic volume between the pectoral nerves (pectoral fascia and clavipectoral fascia) and below the pectoralis minor muscle (middle) of the clavipectoral fascia and outer border. Serratus muscles). In the patient's supine position, the first injection is made in the form of pecs I block and the second is made in the anterior axillary line at a depth of 3-6 cm between the pectoralis minor and the anterior serratus muscle. In this block place the transducer is first in the midclavicular line and it is infero-laterally angle to identify the axillary vein, artery and second rib. The transducer is then moved sideways until the pectoralis minor and serratus anterior are visible. With continuous lateral movements, the third and fourth ribs appear. The local anesthetic is injected into two points: The first injection is usually

made between the pectoralis major and pectoralis minor, and the second injection is made between the pectoralis minor muscles and the anterior serratus.

5.8 Adverse effects of nerve block

Although ultrasound guided nerve blocks have no side effects especially when performed by trained doctors, there are rare cases of traumatic events involving a vessel or temporary sensory injury that lead to sensory or motor impairment and infection at the injection site. In particular, Local Anesthetic Systemic Toxicity (LAST) is one of the complication that an emergency physician should pay attention to. It is a serious life-threatening event with incidence rate of approximately 0.04 [61]. While the LAST presentation is multifactorial, the most prominent neurological presentation [62] includes sensory and visual changes, decreased muscle function, and fainting. However, approximately one-fifth of all cases are characterized by cardiovascular manifestations including motor impairment, myocardial dysfunction, and decreased peripheral vascular tone. Prevention is the key to reducing the frequency and intensity of LAST. These include the use of ultrasound-guided blocks, reduction of the anesthetic dose, selective anesthesia with high levels of CC/CNS side effects (heart failure and central nervous system) [63] including ropivacaine and levobupivacaine, to avoid high-risk patients like patients with advanced age, kidney disease or those with mild heart disease.

6. Conclusion

In conclusion, although new pain management techniques are widely used by emergency physicians to improve patient outcomes both during their emergency stay and during their hospital stay, there are clinical settings where they should still be used but are not explicitly specified. Although neuraxial analgesia using ultrasound guided nerve blocks has been shown to be simpler and easier to perform by trained emergency physicians and provide better and more lasting analgesia, a good pain management protocol with specific step-by-step guidelines is not available in most emergency departments unlike other diseases. Future policy guidelines should address this aspect of emergency management.

Disclosures

None.

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