



Regional anesthesia in the emergency department outside the operating theatre

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Purpose of review

Moderate to severe pain is common and remains a significant problem in the emergency department and regional anesthesia provides optimal and safe pain relief. This review aims to discuss the benefits, indications of the most common ultrasound-guided regional anesthesia techniques that can be provided by clinicians in the emergency department as part of multimodal analgesia. We will also comment on the education and training for effective and safe ultrasound-guided regional anesthesia in the emergency department.

Recent findings

The emergence of multiple new fascial plane blocks that provide easier to learn alternatives, yet effective analgesia for specific patient groups can now safely be taught and utilized in the emergency department.

Summary

Emergency physicians are perfectly placed to utilize the advantages of ultrasound-guided regional anesthesia. Various techniques can now be employed to cover most of the painful injuries presenting to the emergency department, thus modifying the morbidity and outcomes of emergency patients. Some of the new techniques require minimal training, provide safe and effective pain relief with low risk of complications. Ultrasound-guided regional anesthetic techniques should form an integral part of the curriculum of emergency department physicians.

Keywords

emergency medicine, fascial plane blocks, peripheral nerve blocks, Regional anesthesia, ultrasound

INTRODUCTION

One of the fundamental aspects of emergency care is to assess the medical needs of the patients, while providing effective and prompt pain relief. For most patients, this will involve opioid based medication, but clinicians are acutely aware of the potential short and long-term adverse effects of opioid based analgesia such as confusion, altered mental status, respiratory depression and hemodynamic instability. In recent years and subsequent to the availability of portable ultrasound, demand of regional anesthesia in the emergency department has increased, involving ultrasound guided peripheral nerve and fascial plane blocks. Although regional anesthesia techniques have been long established in the emergency department, ultrasound-guided regional anesthesia (USGRA) have invigorated the use of these techniques because of the efficacy of pain relief and safety offered. Indeed, USGRA provides fast and effective analgesia alternative to opioid administration, reduces the need for procedural sedation and carries high patient satisfaction scores [1,2^{*}]. The training curriculum for emergency physicians needs to reflect this practice and therefore

requires adequate exposure in the operating department and training by anesthesiologists to administer safe regional anesthesia. This review will cover most of the commonly used regional anesthesia techniques within the emergency department, comment on the safety and benefits of these techniques and provide information on the education and training of those administering USGRA.

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KEY POINTS

- Moderate to severe pain in the emergency department is common, and ultrasound-guided regional anesthesia provides optimal pain relief.
- Various regional anesthetic techniques can now be employed to cover most of the painful injuries presenting to the emergency department.
- New fascial plane blocks provide easy to learn alternatives, yet effective analgesia for specific patient groups.
- Ultrasound-guided regional anesthetic techniques should form an integral part of the curriculum of emergency department physicians.

ASPECTS OF USGRA RELEVANT TO ALL BLOCKS

The use and success of regional anesthesia techniques within the emergency department has been much more varied in the past depending on individual training of clinicians and the exposure of regional anesthesia techniques within a department. In the past, a limited number of blocks were routinely performed using anatomical landmarks, paresthesia or nerve stimulation techniques, which influenced the success rate and safety of the block depending on individual clinical expertise. As an example, the use of landmark-based fascia iliaca blocks for neck of femur fracture patients have become standard of care in many countries in the last decade. Other options commonly performed, although variable from country to country, were the intravenous regional anesthesia (or Bier's block) and hematoma block. These two techniques were favored by emergency department clinicians because of their relative effectiveness and simplicity. The introduction and availability of portable ultrasound machines into clinical practice has dramatically increased the repertoire of regional anesthesia techniques of clinicians both in anesthesia and the emergency department. USGRA, compared to nerve stimulation or landmark based techniques, have superior success rate, requires less rescue analgesia or sedation and reduces time for block performance [1,2[•]]. USGRA has also demonstrated a lower incidence of local anesthetic systemic toxicity (LAST), because the vascular structures can be visualized in real time and therefore avoided [2[•]] and also because volume of local anesthetic used for block success is reduced [3[•],4] Whenever USGRA techniques are applied, general principles must be adhered to for safe and effective block performance:

- (1) Establishment of intravenous access, for the use of emergency drugs or sedation;
- (2) Full monitoring of the patient inclusive of pulse oximetry, ECG and blood pressure measurement continued for at least 30 min after block performance;
- (3) Sterility of the block procedure but also the ultrasound probe;
- (4) Assistance by a trained health-care provider;
- (5) Familiarity with the equipment used, for example, ultrasound machine;
- (6) Selection of the appropriate needle size, length and bevel;
- (7) Gathering informed consent;
- (8) Adherence to checklists, inclusive of side and site to be blocked confirmation;
- (9) Regular aspiration before local anesthetic injection;
- (10) Avoidance of high resistance on injection and interruption of injection when paresthesia is elicited;
- (11) Calculation of the maximum amount of local anesthetic that can be administered depending on patient's weight;
- (12) Documentation standards including preblock neurological examination and block effect.

BLOCKS PERFORMED IN THE EMERGENCY DEPARTMENT.

As a general principle, the more peripheral blocks are performed, the less complications and adverse effects appear. Clinicians will therefore start with distal peripheral nerve blocks and as their experience and ability increases, nerve blocks more proximal can be included in their daily practice. Often a departmental protocol will specifically dictate which block should be used for a particular injury and which level of clinical expertise should be performing the USGRA, for example, fascia iliaca blocks for neck of femur fracture patients performed by trained nonphysicians [5], or erector spinae plane blocks administered by emergency physicians for rib fracture patient and interscalene blocks performed by anesthesiologists for shoulder dislocations. A recent publication of "plan A blocks" selected high value nerve blocks which could easily gain widespread competency and be easily implemented into clinical pathways as part of multimodal analgesia [6^{••}]. These blocks are to provide the highest possible value to the greatest number of patients, are relatively easy to learn by nonexperts who do not perform regional anesthesia on a regular basis and minimize the risks of complications. These local emergency protocols must further define who should take charge of USGRA for a particular clinical

scenario, but this will vary depending on the clinical expertise, training and experience of the practitioners, which is why collaboration between anesthesia and emergency departments should include regular training of emergency physicians in the operating theatre by anesthesiologists.

UPPER LIMB BLOCKS

Peripheral nerve blocks for the upper limb provide effective pain relief for shoulder, arm, forearm and hand injuries. At the level of the elbow or forearm, the nerves are mostly superficial and can be identified with ultrasound in the forearm with only minimal amount of training. Depending on the injury at the level of the forearm, an axillary brachial plexus block would be necessary but requires more expertise. If this expertise is not available, then a Bier's block can be performed. Unfortunately, there have been case reports where the appropriate equipment and technique were not correctly implemented with dire consequences [7]. Consequently, there has been a decline of this technique in some departments and countries.

Patients with shoulder dislocations or proximal humeral fractures would benefit from a more proximal USGRA technique around the level of the roots, trunks and divisions of the brachial plexus. An interscalene block would provide excellent analgesia but could carry the risk of phrenic nerve palsy and diaphragmatic paralysis. A superior trunk block has a lower risk of phrenic nerve involvement than an interscalene block but may be complicated by vascular structure proximity. Supraclavicular brachial plexus block may also be applied but could potentially carry a risk of pneumothorax if the block is not performed correctly. There are mixed results from various studies that compare interscalene block versus intravenous sedation for the reduction of shoulder dislocations. In a recent publication, the anesthesia time and reduction time was shorter for the intravenous sedation group although the time to hospital discharge was reduced for the interscalene group, with a higher satisfaction level, while pain scores were similar between groups [8].

LOWER LIMB BLOCKS

In a similar fashion to the upper limb, the distal peripheral nerve blocks of the lower limb are usually the first blocks that are performed by clinicians in the emergency department. The branches of the tibial nerve and common peroneal nerve covers most of the lower limb except the cutaneous innervation on the medial aspect of the lower leg including the medial malleolus, which is innervated by

the saphenous nerve which is a branch of the femoral nerve. The significant pain caused by trauma of the foot and ankle area, when the patient is not expected to be weight-bearing after treatment, could easily be managed with an effective sciatic nerve block in the popliteal fossa. When there is a high suspicion of the development of compartment syndrome, such as tibial shaft fractures, then the use of regional anesthesia should be judiciously applied. There is no evidence that low concentration analgesia blocks will mask compartment syndrome [9[■]].

In case of forefoot trauma, an ankle block is an interesting option. This block consists of administering local anesthetic around the tibial, saphenous, superficial peroneal, deep peroneal, and sural nerves. The tibial and deep peroneal nerve blocks can easily be performed with the assistance of ultrasound, while the three others can be blocked with subcutaneous infiltration of local anesthetics.

Various national protocols have been established for the use of regional anesthesia for hip fracture patients presenting in the emergency department because this cohort of patients is particularly vulnerable to the use of opioids for analgesia purposes. Avoiding the potential adverse effects of opioids, with effective regional analgesia could potentially help decrease the morbidity of this elderly patient group [10[■]]. Significant efforts have been made to establish the benefits of regional analgesia as soon as possible, to the extent that some patients are receiving blocks in the prehospital setting, by appropriately trained clinicians [11[■]]. The femoral nerve block is the most commonly performed ultrasound technique for this cohort of patients. Before the availability of ultrasound machines in the ED, a landmark based fascia iliaca block would also be employed as a low risk technique that could often be performed by appropriately trained nonphysician clinical staff. In recent years, various ultrasound guided fascia iliaca blocks above and below the inguinal ligament have been described further improving the efficacy and safety of this technique [12]. These techniques are relatively easy to learn and should be within the remit of emergency physicians treating neck of femur fracture patient. Noteworthy, femoral nerve and fascia iliaca blocks target both the motor and sensory nerves, influencing the motor function of the quadriceps muscle.

THORACIC AND ABDOMINAL WALL BLOCKS

In the past the blocks performed for patients with chest trauma, rib fractures and chest drains, included

technically difficult procedures such as thoracic epidurals or thoracic paravertebral blocks, which may be beyond the scope of most emergency department physicians. The introduction of ultrasound regional anesthesia has also prompted the emergence of fascial plane blocks which are technically less demanding and provide adequate analgesia. Large volumes of dilute local anesthetic are usually injected to open the fascial plane and provide analgesia. These easy-to-perform blocks are associated with a very low complication rate. Serratus plane and erector spinae plane blocks may be particularly useful for patients with rib fracture and might avoid admission to intensive care units for ventilatory support. The erector spinae plane block can be performed at any level on the lateral aspect of the spine and can therefore be implemented for a variety of indications such as pancreatitis, backpain etc. Inter-pectoral plane blocks and pectoserratus plane blocks can also be implemented to provide analgesia over the anterior chest and axilla.

EDUCATION AND TRAINING IN REGIONAL ANESTHESIA FOR EMERGENCY DEPARTMENT CLINICIANS

Regional anesthesia is usually the remit of anesthesiologist but with the multifunctional use of bedside ultrasound in the emergency department for vascular access, cardiac, lung and abdominal examinations, USGRA would lend itself to easily to be established as part of emergency department physicians core skills. In the past, the usual progression would be an emergency department clinician with regional anesthesia enthusiasm trying to teach basic skills to colleagues and trainees. A large majority of current well established emergency department physicians have not had formal USGRA training and therefore lack the experience and knowledge to train a new generation of residents. There is large variation in the learning process of USGRA: some may have had exposure as part of an anesthesia rotation, others have attended specific courses, supervised practice from colleagues or online resources. In some institution, emergency department physicians are invited to the operating theatre to gain exposure and experience in performing a particular nerve block for a particular group of patients such as fascia iliaca blocks or femoral nerve blocks for neck of femur fracture patients. Usually, there will be retention of skill over a 3-month period if there is continuous exposure to the procedure. In other hospitals, anesthesiologists are available in the emergency department to teach, guide and educate regional anesthetic techniques to emergency department clinicians. It is unrealistic and

unfeasible that the increasing demand for USGRA in the emergency department can be met by an acute pain team or roaming block anesthesiologist to provide a 24/7 service in the emergency department. Certainly, the way forward is a multidisciplinary collaboration between anesthesiologist and emergency department clinicians [13], providing training and educational support on a fixed and regular basis and also establishing joint protocols for the use of USGRA in the emergency department. In a recent survey 84% of academic emergency departments in the United States routinely use USGRA, but only 7% have a formal USGRA curriculum pathway [14]. Over time different academic emergency departments will require training programs to incorporate USGRA into the curriculum. Noteworthy, a consensus statement from emergency department experts defined the key components of USGRA curriculum for EM and identified 10 techniques that are beneficial to the practice of emergency department [15].

Part of the education and training of performing blocks is to prevent, recognize and manage complications. Clinicians must be aware of these complications as they relate to each block because this will form the basis of informed consent. Some of the general risks related to regional anesthesia include block failure, peripheral nerve injury, LAST and hematoma.

There may be multifactorial reasons why an adequate block could not be established such as incorrect dose and volume of local anesthetic, incorrect block for procedure, or technical difficulties in visualizing the target nerve. Clinicians should know how to manage these situations and provide patients with an alternative form of analgesia or sedation or perform the appropriate rescue blocks. Reducing the risk of peripheral nerve injury usually involves preventive strategies such as avoiding high injection pressure, the use of nerve stimulation in conjunction with ultrasound guidance and avoiding paresthesia. Although the introduction of UGRA has reduced the incidence of LAST, from 1:1000 to 1: 16 000 [3⁴], clinicians need to be aware of the factors influencing the maximum local anesthetic plasma level, the maximum dose of each local anesthetic used, how to recognize and manage the often subtle and unpredictable clinical presentation of local anesthetic toxicity, including the use of intravenous 20% lipid emulsion (Intralipid), which must be readily available in all clinical areas where USGRA is performed. Most hospital's anesthesia and emergency departments would store the lipid emulsion in the cardiac arrest trolleys. The number of patients presenting in the ED on antithrombotic drugs have dramatically increased. A risk benefit analysis of a regional

anesthesia block should be considered for these patients.

CONCLUSION

Emergency physicians are perfectly placed to utilize the advantages of USGRA and provide early, opioid sparing analgesia that can modify the morbidity and outcomes of patients presenting with a wide variety of painful injury and fractures. Some regional anesthetic techniques are more commonly provided for specific injury protocols or patient groups and initial education and training for essential common blocks should be part of the emergency department curriculum. Consistent exposure, teaching and training standards should be set. Once safe and effective USGRA routine is firmly established, performance of more blocks will become routine practice in most departments.

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