Ultrasound-Guided Regional Anesthesia in the Emergency Department: A Scoping Review

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Introduction

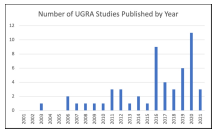
Pain-related complaints are the most common reason patients seek care in the Emergency Department (ED).[1] Despite pain's ubiquity, its management in the ED can be challenging for patients and physicians alike and the undertreatment of pain remains a pervasive problem. [2,3] An estimated 20-50% of patients report dissatisfaction with the pain management care they received in the ED. [4,5]

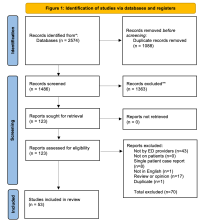
Ultrasound guided regional anesthesia (UGRA) is a safe and effective intervention to attenuate pain and spare use of opioid pain medication.[6] Nerve blocks deliver medications directly to the offending nerve or fascial plane, allowing targeted modulation of neural signals. They decrease length of stay and increase patient satisfaction. They have also been shown to be as effective as parenteral opioids at treating pain while avoiding the adverse effects like sedation, delirium, and respiratory depression.[7,8]

The advent of point-of-care ultrasonography has made these procedures much more feasible in the ED. Emergency physicians can be trained to perform various nerve blocks and the accessibility of ultrasound machines in emergency departments has made these procedures more successful and safer. Landmark guided nerve blocks have up to a 20% failure rate; with direct ultrasound visualization, image guided nerve blocks are successful >90% of the time.[9,10] Additionally, POCUS and needle visualization has decreased the risk of complications, such as inadvertent intravascular local anesthetic injection and pneumothorax. Nerve blocks are well studied in anesthesia literature and their effectiveness in perioperative patients is well documented. However, the number and quality of studies analyzing different block techniques in the ED is unknown. To the best of our knowledge, our study is the first comprehensive scoping review of the literature on UGRA in the ED setting.

Methods

We conducted a scoping review of the current available literature on different types of UGRA procedures performed by ED providers in the ED. With the help of a medical librarian, we searched EMBASE, MEDLINE, CINAHL, and Cochrane databases for citations published in any year through May 18, 2021. A total of 2,574 studies were identified by the initial search. After removal of duplicate results, 1,486 were selected for Level 1 abstract eligibility review.





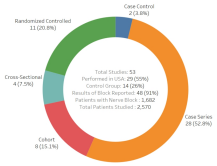
Inclusion and Exclusion Criteria

Studies were included if they described an UGRA technique performed on patients in the ED and performed by ED providers. "UGRA technique" was defined as "a technique that utilizes real-time ultrasound guidance to assist anesthetic medication injection near a peripheral nerve or associated fascial planes to provide sensory blockade". ED providers were defined as "attending/faculty Emergency Physicians, resident physicians under supervision, emergency medicine fellows, and Physician Assistants and Nurse Practitioners under supervision". Studies on both adult and pediatric patients were included. Exclusion criteria included cadaver studies, phantom model studies, single-patient case reports, systematic review articles, meta-analyses, blog posts, opinion pieces, commentaries, website publications, conference abstracts, and studies not published in English.

Data Collection and Processing

Reviewer teams underwent a brief training on data extraction and extracted data into a structured survey form. Data collected from full manuscripts includes author last name, study title, year published, type of nerve block technique, body location(s) anesthetized, indication(s) for nerve block, study design, total number of patients studied, presence of a control group (if control group present, number of patients in each study arm was extracted), patient demographic information, nerve block complications reported, anesthetic agent used and reported results of nerve blocks. Data were compiled for results analysis. Study characteristics were summarized using descriptive statistics. Inter-observer agreement was calculated by Distiller SR (Ontario, Canada) using the Cohen's Kappa. Interpretation of Cohen's Kappa conformed to Landis and Koch.[11]

	Study Type				
Nerve Block Type	Case Control	Case Series	Cohort	Cross-Sectional	Randomized Controlled
Brachial Plexus (infraclavicular and su...		1(5/5)			2(37/72)
Brachial Plexus (Interscalene)		1(4/4)	1(14/14)		2(51/102)
Cervical Plexus		1(27/27)			
Erector Spinae		5(23/23)			
Fascia Iliaca		1(20/20)	2(50/131)		
Femoral Nerve	2(690/1,038)	1(2/2)	2(108/108)	2(92/97)	4(141/314)
Forearm (radial/ulnar/median nerve)		4(33/33)		1(11/11)	2(33/66)
Greater Auricular Nerve		1(2/2)			
Multiple nerve blocks were studied		2(50/50)	3(176/318)	1(50/50)	
Pericapsular Nerve Group (PENG)		1(3/3)			
Sciatic Nerve		2(7/7)			
Serratus Plane		3(18/18)			
Superficial Cutaneous (SCALD ED)		1(2/2)			
Supracondylar Radial Nerve		1(4/4)			
Suprascapular Nerve		1(2/2)			1(21/41)
Transversus Abdominis Plane (TAP)		2(6/6)			



Results

- 14 studied either fascia iliaca or femoral nerve block, 7 the brachial plexus block techniques (infraclavicular, supraclavicular, or interscalene); 7 forearm nerve block (radial, ulnar, or median nerve); 5 erector spinae plane block; 3 serratus plane block; 2 suprascapular nerve block; 2 transversus abdominis plane block; 2 sciatic nerve block; 1 cervical plexus block; 1 greater auricular nerve block; 1 pericapsular nerve group (PENG) block; 1 superficial cutaneous (SCALD ED) block; and 1 supracondylar radial nerve block. 6 studies included multiple nerve blocks.
- 14 studies involved a control group, of which 7 used procedural sedation as a control. 50 studies collected demographic data. Of these, 10 studies were performed on elderly patients (defined as age > 65), 33 studies analyzed adults > 18, 2 analyzed pediatric patients only (age < 18), and 7 studies analyzed both pediatric and adult patients. Indications for nerve blocks included fractures, zoster, sciatica, back pain, dislocation reduction, lacerations, and abscesses. The most common nerve block indication was hip fracture (14 studies)
- The study type is detailed in Figure 2. Study type was variable including 28 case series, 11 randomized control trials (RCTs), 8 cohort, 4 cross sectional, and 2 case-control. Figure 4 details study type and number of patients studied by nerve block. Nerve blocks evaluated by RCTs included 4 brachial plexus (infraclavicular, supraclavicular, and interscalene), 2 forearm nerve (radial, ulnar, or median nerve), 4 femoral nerve, and 1 suprascapular nerve block studies. 28 case series studied a total of 208 patients. The average number of patients evaluated per case series was 7.4. 11 RCTs enrolled a total of 595 patients of which 283 patients underwent a nerve block and 297 were given a control intervention (15 patients were excluded from final analysis in Morrison, et al). The most common control interventions in RCTs were parenteral opioids or procedural sedation. Reid, et al used a fascial-pop, landmark guided femoral nerve block as their control intervention. Beaudoin, et al used morphine in combination with a sham (saline) femoral nerve block as their control. Forouzan, et al controlled using a femoral nerve block with nerve stimulator guidance.
- 30 (57%) studies reported complications of nerve blocks. Complications evaluated for included local anesthetic systemic toxicity (LAST), bleeding, neurologic symptoms, local tenderness, motor deficit, ambulatory difficulty, discomfort during procedure, block failure, need for additional anesthesia, pneumothorax, hemodynamic compromise, cardiac arrythmia, and hematoma. 48 (91%) studies reported outcomes of the nerve block. Reported outcomes included pain scores, duration of analgesia, long term patient functional outcomes, patient satisfaction, provider satisfaction, success of reduction attempts, number of attempts, ED length of stay, opioid use after regional anesthesia. The most used pain score was the visual analogue scale (VAS), reported in 9 studies.

Discussion

This review demonstrated an increasing number of publications describing ultrasound guided regional anesthesia performed in the ED. Most of these publications were case series describing a particular nerve block technique. The most studied technique was the femoral/fascia iliaca nerve block, both in terms of total studies and in total numbers of patients. Collectively, these findings outline the areas of strength and weakness in the literature supporting ultrasound guided nerve blocks in the emergency department.

Most publications in our review were case series, with smaller proportions of randomized controlled trials, cohort studies, or case control designs. This is most likely due to the ease in performing these types of studies for investigators and the inconsistency in available patients with indications for a specific block type. There may also be barriers to institutional review board approval of randomized studies given limitations of the literature base. There may be additional barriers due to variability in training of ED providers, lack of nerve block privileges for ED providers, and relationships with other departments that perform nerve blocks[18].

Our review represents a wide breadth of nerve block types that have been studied in the ED. The best represented techniques were the femoral nerve and fascia iliaca blocks. This may have been influenced by the publication of an early landmark randomized trial[12] strong support from the anesthesia[19] and orthopedic surgery literature[20], and the availability of eligible patients in the ED. The forearm nerve blocks (median, radial, and ulnar) were also well represented. These techniques are among the least technically challenging nerve block procedures making them more accessible for study in providers less experienced in nerve blocks. This may also explain fewer numbers of publications in nerve block techniques considered to be more technically challenging and with more serious potential complications such as the infraclavicular brachial plexus nerve block.

Limitations

Our study does have several limitations. We may not have captured every article on ultrasound guided nerve blocks despite our broad search strategy. Publication bias may have prevented studies, especially those with negative or neutral results, from being published and therefore included in our review. Excluding studies not in English may have also biased our review toward those studies published in English-speaking countries. Studies of single patients receiving an ultrasound guided nerve block procedure were excluded, and the relative totals of publications for each block was likely impacted. However, this strategy enriched our review in studies with higher numbers of enrolled patients that are likely to have stronger methodology. In some studies, it was not entirely clear if an ED provider performed the nerve block procedure. However, we used a conservative approach during abstract screening, such that these studies had full text review by two reviewers and possibly a third if there was disagreement. Due to the inconsistency in reported outcomes, we were not able to perform a meta-analysis and investigate the overall safety or efficacy of these procedures.

Conclusion

The results of this first scoping review of ultrasound guided nerve blocks performed by ED providers showed that a variety of blocks are utilized in the emergency department to manage a diversity of conditions, and that interest in these procedures is growing. Our hope is that this review can serve as a guide for those investigators who aim to study promising techniques that do not yet have strong support in the literature. Given the sporadic nature of availability of each procedure, there may be a benefit to collaborative multicenter research networks to pool data from many institutions. A dataset containing a large number of block procedures may provide strong evidence of the safety of these techniques in the hands of ED providers.

We were not able to perform a meta-analysis of outcomes in this review as outcomes were inconsistently reported. An effort to standardize outcome reporting, including pain assessments, timing of pain assessment, and definitions of complications would allow for clearer interpretation of results and easy comparison of outcomes across studies. In addition, all efforts should be made to compare outcomes against usual care whether that be intravenous analgesia or procedural sedation. Finally, investigators should pay particular attention to outcomes involving avoidance of opioid pain medications as this holds great promise for the utility of nerve blocks.

By continuing to build a strong literature base for ultrasound guided nerve blocks performed by ED providers, we can ensure that the safety and efficacy of these procedures are further demonstrated. Our hope is that ED providers can feel empowered to perform ultrasound guided regional anesthesia for the benefit of their patients.

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