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Ultrasound Guided Peripheral Nerve Blocks

Introduction

1. The opioid epidemic has led ED providers to investigate effective opioid-sparing pain management strategies.
2. The provision of ultrasound-guided nerve blocks (UGNBs) is endorsed by the American College of Emergency Physicians (ACEP) as a core skill for emergency physicians and a core component of a multimodal pain pathway.[1]
3. Current literature supports the use of UGNBs as part of "pre-procedural pain management for orthopedic reductions/splinting, complex laceration repair, abscess incision and drainage, or acute on chronic pain conditions".[1]
4. Ultrasound guidance has been shown to reduce time to nerve block onset and improve the quality of peripheral nerve blocks when compared to other techniques.[2]
5. UGNBs have been associated with improved post-surgical functional outcomes, decreased delirium, and decreased length of stay. [2]

General Contraindications for Peripheral Nerve Blocks[3]

Infection at site of injection
Non-responsive/non-verbal patient
Hardware at or near planned injection site
Pre-existing nerve injury or peripheral neuropathy
Concern for development of compartment syndrome at the site of injury
Allergies to local anesthetics
Crush injury at or near the site of injection

Potential Complications of Peripheral Nerve Blocks[3]

Local anesthetic toxicity
Nerve injury
Ecchymosis
Hematomas

Regional Anesthetic Pharmacology[4]

MOA	Anesthetics bind to sodium channels on nerve cells and prevent subsequent depolarization and further nerve impulse conduction until the anesthetic is displaced from the neuronal membrane				
Agents	Lidocaine	Lidocaine w/ epi	Bupivacaine	Ropivacaine	Mepivacaine
Max Dose (NTE)	4.5 mg/kg (300 mg)	7 mg/kg (500 mg)	2 mg/kg (175 mg)	3 mg/kg (300 mg)	4 mg/kg (300 mg)
*Dose will vary with block location due to differences in vascularity, size of the nerve, and the duration of anesthesia required					
Onset	4-7 min	4-7 min	~20 min	~15 min	~10 min
Duration of Analgesia	~2 hours	~3-4 hours	~6-8 hours	~6-8 hours	~2-3 hours
Admin	• Sterile technique should be used for all nerve blocks • Amount of local anesthetic will vary, may dilute local anesthetic 1:1 with NS to achieve required volume				
Risks	• Pregnancy increases neural susceptibility to local anesthetics • Local anesthesia systemic toxicity (LAST): confusion, anxiety, headache , drowsiness, tremors, hemodynamic collapse, widened PR interval, QRS prolongation, VT, VF, hypotension, asystole • Local nerve injury				

Review of the Evidence

Author, year	Design & Sample Size	Patient Population	Intervention & Comparison	Outcome
Beaudoin et al., 2013[5]	Randomized controlled trial (N=36)	Adults ≥55 yrs w/ confirmed hip fractures AND pain score ≥5	• FNB: US-guided 3-in-1 femoral nerve block w/ 25 mL bupivacaine 0.5% + morphine • SC: NS injection + morphine	• Pain scores were lower with FNB at 15 min and at 4 hours vs SC group (4 [0-10] vs 8 [6 -10]) • FNB group received less rescue opioids than the SC group (0 mg [0-6 mg] vs 5 mg [0-21 mg])
Bhoi et al., 2012[6]	Prospective observational feasibility study (N=50)	Patients ≥5 yrs requiring analgesia for acute limb emergencies	Brachial plexus block: 3-5 mg/kg lidocaine 2% Femoral and sciatic block: 3-5 mg/kg 2% lidocaine +/- 1-2 mg/kg 0.5% bupivacaine	• No patients required rescue analgesia • Reduction in VAS pain score of 7.44 (IQR 8-10 [75%], 1-2 [25%]; p=0.0001) • Median time to reduction of pain: 5 min (IQR 1, 15 min) • No immediate or late complications at 3-month follow-up
Mori et al., 2019[7]	Retrospective case series (N=6)	UG ulnar nerve block prior to phalangeal reduction in pediatric patients	0.1-0.2 ml/kg lidocaine 1%	• No patients required additional analgesia • All patients were discharged home after completion of reduction • No documented complications
Cisewski & Alerhand, 2019[8]	Case series (N=2)	Patient 1: 4 cm 2nd degree burn Patient 2: 2-3 cm area of cellulitis	Lateral sural cutaneous nerve (LCSN) sensory block: 5 mL lidocaine w/ epi	• Onset: 7-9 min • Peak analgesic effect: 25-29 min • Duration: 120-150 min • No motor deficit or adverse effects
Barton et al., 2018[9]	Case report (N=1)	44 yr male with copperhead bite to left hallux	Fascia iliaca compartment block: 20 mL 0.25 % bupivacaine	• Time to pain relief: 45 min • Duration: 8 hours • No adverse effects, discharged 48 hours after admission
Blaivas et al., 2011[10]	RCT (N=42)	Patients in the ED with shoulder dislocations	Procedural sedation/ analgesia: etomidate Interscalene brachial plexus block (ISBPB): 20-30 mL lidocaine w/ epi	• ED length of stay slower with ISBPB (100.3 +/- 28.2 vs. 177.3 +/- 37.9 min) • Mean 1-on-1 provider time less with ISBPB (5 +/- 0.7 vs 47.1 +/- 9.8 min) • No significant difference in patient satisfaction, pain experienced or complications (hypoxia, hypotension) • Transient motor paralysis did occur in all patients that received ISBPB

*NS=normal saline

Common Peripheral Nerve Blocks*

Block Type	Uses	Suggested Anesthetics	Suggested Volume	Clinical Pearls
Superficial cervical plexus block	Earlobe lacerations, neck abscess, central line placement	Lidocaine 1% w/ epi	5-8 mL	Provides sensory blockade without motor blockade. Sensory nerves require lower concentrations of local anesthetic.
Interscalene brachial plexus block (ISBPB)	Shoulder dislocations Proximal humerus fracture reduction	Lidocaine 1%	10 mL	Phrenic nerve blockade, sympathetic chain blockade, recurrent laryngeal nerve blockade, spinal cord root injury
Supra/Infra-clavicular brachial plexus block	Distal humerus fractures Elbow fractures Forearm fractures Upper arm skin soft tissue injuries	Ropivacaine 0.5% or lidocaine	20-25 mL	Lower risk of phrenic nerve involvement than the interscalene approach but pneumothorax is a rare but serious complication

Axillary brachial plexus block	Wrist/elbow/forearm bony injury	Lidocaine +/- epi Ropivacaine Bupivacaine	15-20 mL (3-5 mL) per nerve	Choice of LA will depend on desired duration of anesthesia
Axillary brachial plexus block + musculocutaneous nerve block	Forearm skin soft tissue injury	Lidocaine +/- epi Ropivacaine Bupivacaine	15-20 mL (3-5 mL) per nerve	Choice of LA will depend on desired duration of anesthesia
Wrist block	Hand bony or soft tissue injuries distal to wrist	Lidocaine 1%	3-5 ml per nerve	Does not provide analgesia for wrist fractures
Intercostal block	Rib fractures Chest tube placement	Ropivacaine Lidocaine	3-5 mL per nerve	**High risk of cardiotoxicity, avoid bupivacaine**
Serratus anterior plane (SAP) block	Rib fractures Chest tube placement Thoracotomy Chest wall or breast abscess	Ropivacaine Lidocaine +/- epi	30 mL	**Volume is essential for any plane block.** May dilute 1:1 with NS to achieve adequate volume
Erector Spinae plane block	Posterior rib fractures Chest trauma	Ropivacaine	30 mL	**Volume is essential for any plane block.** May dilute 1:1 with NS to achieve adequate volume
TAP/ilioinguinal/iliohypogastric plane block	Hernia reduction ABD wall soft tissue injuries/abscesses	Lidocaine Ropivacaine Bupivacaine	30 mL	**Volume is essential for any plane block.** May dilute 1:1 with NS to achieve adequate volume
Fascia iliaca compartment block (FIB)	Hip fractures Femoral shaft fractures	Bupivacaine 0.25% Ropivacaine 0.25%	20-40 mL	**Volume is essential for effective FIB!** May dilute 1:1 with NS to achieve adequate volume
Popliteal-sciatic (saphenous supplement) block	Distal tib/fib fractures Lower leg SST injuries Lower leg abscesses Foot injuries	Lidocaine 1% Ropivacaine 0.25% Bupivacaine 0.25%	10-20 mL	
Posterior tibial block	Soft tissue injury to sole of the foot Foreign body removal Calcaneus fractures	Lidocaine 1%	5 mL	

*Adapted from NYSORA.com

Conclusions

- UGNBs have the potential to improve pain control, reduce opioid use, and improve patient outcomes.
- The choice of local anesthetic should be based on the site of the block and the desired duration of analgesia.
- There is currently inconclusive evidence for or against the benefits and risks of combining vasoconstrictors with local anesthetics to alter onset and duration of analgesia.

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