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Utilizing Ultrasound-Guided Femoral Nerve Blocks and Fascia Iliaca Compartment Blocks for Proximal Femur Fractures in the Emergency Department

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ABSTRACT
Proximal femur fractures (PFF) are one of the many common injuries that present to the emergency department (ED). The current practice for pain management utilizes systemic opioid analgesics. The use of opioids is an excellent analgesic choice, but they carry a significant burden for potential adverse effects. It is vital that providers have a variety of approaches to acute pain control. The use of femoral nerve blocks (FNBs) and fascia iliaca compartment blocks (FICB) are an alternative method of pain control in the ED. They have advantages over systemic opiates in that they do not require hemodynamic monitoring, have less adverse effects, and more importantly they induce rapid pain control with longer duration than systemic analgesics (Cross & Warkentine, 2016). This manuscript examines a review of literature and identifies the efficacy, patient safety, indications, contraindications, patient satisfaction, and ultrasound-guided FNB and FICB techniques. **Key words:** emergency department, fascia iliaca compartment block, femoral nerve block, proximal femur fracture, ultrasound-guided

A 68-YEAR-OLD WOMAN was transported to the emergency department (ED) via ambulance after a mechanical ground-level fall while walking her dog. Upon examination, she was found to have a shortening of her right lower extremity with

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external rotation. Circulation, motor function, and sensation were intact with two plus dorsalis pedis and posterior tibial pulses. She denied loss of consciousness, and no other visible trauma was noted.

The patient was then seen by the provider, and intravenous access was obtained. The patient weighed 80 kg (176 lb), had no major comorbidities, and was opiate naive. Because of her history of being opiate naive, morphine 2 mg was administered intravenously to address her acute pain. After the administration of morphine, she was transported to radiology for complete hip and pelvis radiography. To obtain the best optimal views, her leg was manipulated in ways that exacerbated her pain. An additional 2 mg of morphine was administered intravenously without adequate pain relief. Her radiographs showed an intratrochanteric fracture of the right femur.

After the two doses of morphine were administered, the patient was still complaining of 9/10 pain. On examination, she was alert and oriented, her vital signs were stable, and her respiratory drive was at her baseline.

The provider then ordered fentanyl 50 mcg intravenously for pain control and was administered by the nurse. During the reassessment 1 hr later, the nurse noticed that the patient was lethargic with shallow respirations. A nonrebreather mask was quickly applied, but because of the concern about her airway, she was emergently intubated. In the intensive care unit (ICU), she was ruled out for other causes of respiratory failure, including a pulmonary and fat embolus. The next day, the patient was extubated and the opioids were deemed the cause for her hemodynamic instability.

INTRODUCTION

Hip fractures occur in approximately 341,000 persons in the United States each year (Davenport, 2016). Proximal femur fractures (PFF) are extremely painful injuries that benefit from prompt pain control. Hip fracture pain is poorly managed and is often problematic because of one's advanced age, comorbidities, and increased sensitivity to side effects of systemic analgesic (Pageau, Perry, Ritcey, & Woo, 2016). A phenomenon known as "oligoanalgesia" is the inability to provide adequate analgesia for acute pain. It is common among trauma patients in the prehospital and ED settings (Samet & Slade, 2018). Adequate pain control is not just humane but also decreases a patient's risk of delirium and length of hospital stay (Faux, Scurrah, Shiner, & Stevens, 2018). Acquiring adequate pain control will allow for earlier mobilization and help assist patients back to their normal lifestyle (Sanzone, 2016).

The standard of care for managing PFF pain involves administration of oral, intramuscular, or systemic opioids (Holroyd-Leduc, Ospina, & Riddell, 2015). Although opioids are excellent analgesics and an acceptable choice, they carry an increased risk for potential adverse effects, including respiratory depression, delirium, and vasodilation causing hypotension, increased staffing requirement to monitor patients, and increase in the patient's length of stay in the ED (Gadsden & Warlick, 2015).

One alternative to systemic opiates is the peripheral nerve block (PNB), specifically the femoral nerve block (FNB) and fascia iliaca compartment block (FICB), which have been shown to be an effective alternative approach to acute pain control in the ED. These approaches are proven to lower rates of complications and avoid respiratory depression and hypotension that opioids produce, especially among the elderly (Holroyd-Leduc et al., 2015). They also provide rapid and longer lasting pain control and can be used in conjunction with opioids to reduce the total dosage needed (Samet & Slade, 2018).

In a recent systematic review, multiple authors looked at the literature for the potential methods of analgesia for hip fractures. They reviewed a total of 83 studies. These studies included multiple analgesic options for PFFs that included nerve blockade, spinal anesthesia, systemic analgesia, neurostimulation, traction, and alternative medicine. Within this review, PNBs were deemed to be the most effective analgesic option for reducing acute

pain without the associated problems that opiates produce (Abou-Setta et al., 2011).

Peripheral nerve blocks can be performed by physicians and advanced practice providers (APPs) in the ED with the proper training. Their use has primarily been limited by practitioner comfort, concern about technical difficulties, and lack of training. Providers with minimal training and experience with ultrasound-guided PNBs were able to successfully perform this procedure to obtain adequate regional anesthesia (Bhoi, Chandra, & Galwankar, 2010). It has been demonstrated that with the appropriate training, APPs without anesthetic background can successfully perform a PNB (Grigg, Obideyi, Randall, & Srikantharajah, 2008).

WHAT IS A PERIPHERAL NERVE BLOCK?

A PNB is a form of regional anesthesia where an injection of anesthetic is locally delivered near specific nerves to obtain pain control by blocking the nerve conduction. Peripheral nerve blocks are more commonly used in the operating room to provide both intraoperative and postoperative pain control. However, PNBs are not limited to the operating room. The ED is utilizing them for rib fractures, upper and lower extremity trauma/reductions/traction/pinnings, and evacuation of an abscess. There are many different types of PNBs including FNB and FICB, both of which are used to manage acute and chronic pain. They have the advantage of immediate pain relief and can also offer long-term relief through the reduction of nerve irritation that allows for improved healing (Columbia University Department of Neurology, 2015).

EFFICACY AND SAFETY

Ultrasound-guided PNB is a safe, reliable alternative to systemic analgesia and procedural sedation. It is an effective intervention for the management of acute extremity pain while in the ED (LaPietra, Motov, & Rosenberg, 2016). There are advantages to performing FNB or FICB as early as possible. These advantages include significantly lower pain scores, decreased opioid requirements, assistance in the reduction of a fracture, and facilitation in patient positioning (Adhikari, Amini, Kartchner, & Nagdev, 2015; Choi, Lin, & Gadsden, 2013). Peripheral nerve blocks also contribute to a patient's overall health by reducing pain with movement within 30 min after administration, decrease the risk of pneumonia, shorten the amount of time that is needed for first-time ambulation, and reduce the cost of the analgesics (Griffiths, Guay, Kopp, & Parker, 2018).

A study looked at the significance of the feasibility of ultrasound-guided FNB and its effectiveness as an alternative for pain management in the ED. Within the study, PNBs required only a single attempt, there were no complications, and there were significant findings (44% and 67%) with a relative decrease in pain scores at 15 min ($p \leq 0.002$; Beaudoin, Becker, Merchant, & Nagdev, 2010). Providing a PNB is a safe alternative that requires a minimal amount of local anesthetic or prolonged postprocedure observation (Bhoi et al., 2010). Patients who received an FNB reported a decrease in their pain scores when compared with traditional management with systemic opioids (Lollo, Grabinsky, & Wu, 2011).

In addition, the use of PNBs has been shown to improve analgesia more rapidly and increased patient satisfaction scores compared with systemic and intramuscular opioid administration (Lollo et al., 2011). Femoral nerve blocks require fewer systemic opioids and significantly contribute to higher patient satisfaction compared with patients receiving standard of care (Holroyd-Leduc et al., 2015).

COMPLICATIONS

There are always risks involved and potential complications when performing a PNB. Complications include peripheral nerve injury, allergic reaction, local anesthetic toxicity, hematoma, infection, and a secondary injury that includes reduced sensation after

a nerve block (Chang & White, 2017). The risk of infection is minimized with strict sterile technique. Under ultrasound guidance, the actual risk of peripheral nerve injury is extremely low (<0.1%).

Whenever regional anesthesia is being performed, resuscitation equipment should be readily accessible in the event of local anesthetic toxicity (Buck, Devroe, Missant, & Van de Velde, 2012). Signs of local anesthetic systemic toxicity start with central nervous system (CNS) findings and can progress to cardiovascular collapse. Typical signs and symptoms consist of confusion, reduced level of consciousness, audio–visual disturbances, dizziness, seizures, arrhythmias, and hypotension that could lead to cardiac arrest (Chin, El-Boghdadly, & Pawa, 2018). Patients should be placed on a cardiac monitor with pulse oximetry while receiving an FNB or FICB.

INDICATIONS FOR PERIPHERAL NERVE BLOCKS

Peripheral nerve blocks should be considered as an adjunct or alternative to opiates in those patients at risk for respiratory depression, those with suspected difficult airway, those who prefer to remain conscious or avoid systemic medications, outpatients who will benefit from prolonged profound analgesia, patients with acute severe pain, and those who have been poorly managed with systemic medications and to minimize opioid use (Jeng & Rosenblatt, 2018). Indications specifically for FNB and FICB are femoral neck fractures, femur fractures, patellar injuries, and thigh abscess drainage (Mallin & Nagdev, 2010).

CONTRAINDICATIONS FOR PERIPHERAL NERVE BLOCKS

There are a few absolute contraindications that include refusal, inability to cooperate, and allergy to anesthetic agents (Jeng & Rosenblatt, 2018). Relative contraindications for a nerve block include current infection at the site of injection, patients taking antithrombotic drugs, those who have coagulopathy issues, especially in noncompressible anatomical locations, and preexisting neural deficits in the distribution of the block (Jeng & Rosenblatt, 2018). Special consideration should be made for patients in whom there is a concern for the development of compartment syndrome. Peripheral nerve blocks have the potential to mask the symptoms of the development of compartment syndrome, which makes it difficult to differentiate. Contraindications specifically for FNB and FICB are crush injuries around the anatomical site of the block and a history of femoral bypass to the PNB region.

OVERVIEW OF THE FEMORAL NERVE BLOCK AND FASCIA ILIACA COMPARTMENT BLOCK

Both FNB and FICB are regional anesthesia techniques that involve an injection of local anesthetic around the femoral nerve and/or under the fascia iliaca. An FICB is considered to be the technically easier approach. The more direct FNB and indirect FICB techniques control PFF pain by blocking pain signals directly on the femoral nerve (Cross & Warkentine, 2016). A study of 100 participants found that ultrasound-guided FNB and FICB had equivalent analgesia in patients with a PFF (Goudie, Nagree, Cooper, Watson, & Arendts, 2018). Both FNB and FICB should be performed using sterile technique.

HOW TO PERFORM THE FEMORAL NERVE BLOCK AND THE FASCIA ILIACA COMPARTMENT BLOCK

Femoral Nerve Block

The femoral nerve lies lateral to the femoral artery and vein at the level of the inguinal ligament. When using the ultrasound-guided approach, the transducer is placed in the inguinal crease to locate the femoral nerve. The nerve is lateral to the hypoechoic pulsatile common femoral artery, superficial to the iliopsoas muscle group, and deep to the fascia lata and fascia iliaca (Jeng & Rosenblatt, 2018).

Under ultrasound guidance, the needle is inserted into the tissue and guided so that the tip is adjacent to the nerve. Meticulous detail is warranted to avoid intravascular injection of anesthetic. This is achieved by negative aspiration prior to injection. Aspiration of blood suggests that the needle is intravascular, and the provider should not inject anesthetic. After negative aspiration, inject 20–40 ml of local anesthetic in 5-ml increments, with gentle aspiration between injections (Jeng & Rosenblatt, 2018). On the ultrasound monitor, local anesthetic should be seen spreading above, below, or circumferentially around the nerve. The clinician should anticipate the distribution of anesthesia to the anterior and medial thigh down to the knee, as well as a section of skin on the medial leg and foot (New York School of Regional Anesthesia, 2019). Figure 1 illustrates an ultrasound-guided view of FNB.

When performing the landmark technique, ultrasound guidance is not utilized. Start by identifying the anterior superior iliac spine and the pubic symphysis and visualize a line between these two landmarks. This line represents the inguinal ligament. The femoral nerve passes through the center of the inguinal ligament. The femoral pulse should be identified at the level of the inguinal ligament before positioning the needle. The goal is to place the needle tip directly lateral (1 cm) to the pulsatile artery in the inguinal crease (Bleckner & Buckenmaier, 2009, p. 54). Figure 2 illustrates the anatomical landmarks for FNB.

Fascia Iliaca Compartment Block

An FICB is a similar regional nerve block that involves injecting local anesthetic beneath the fascia in the proximal thigh. In the FICB approach, the femoral, obturator, and lateral cutaneous nerves are generally blocked while avoiding the femoral artery (Cross & Warkentine, 2016). Although FICB uses a larger volume of anesthetic than FNB, it is the technically easier than the PNB to perform.

When using the ultrasound-guided approach, an imaginary line is drawn between the anterior superior iliac spine and pubic tubercle and divided into thirds. An ultrasound probe is placed transversely to the leg at the junction between the middle and lateral thirds to identify the fascia lata, iliacus muscle, and fascia iliaca. The needle is introduced in-plane

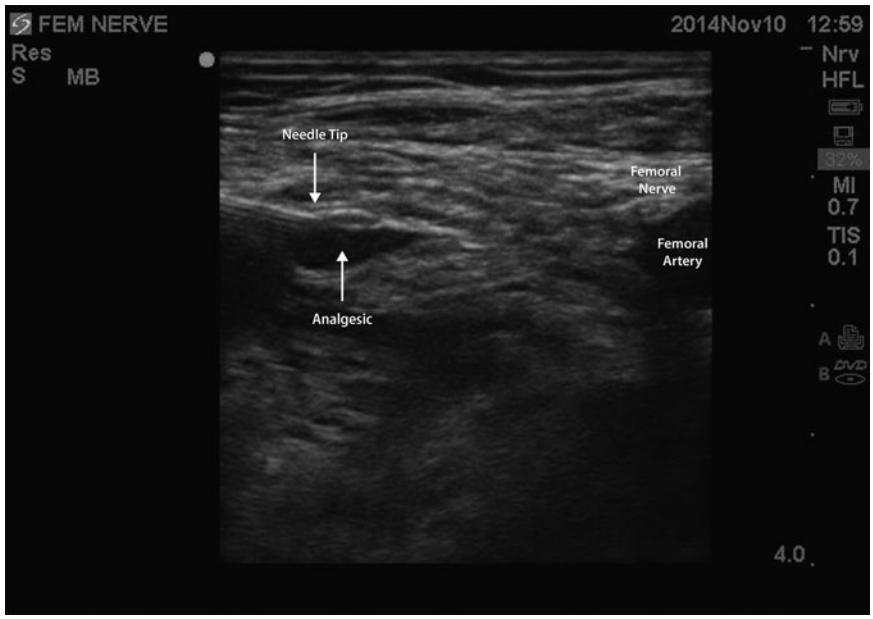

Figure 1. Ultrasound-guided right femoral nerve block.

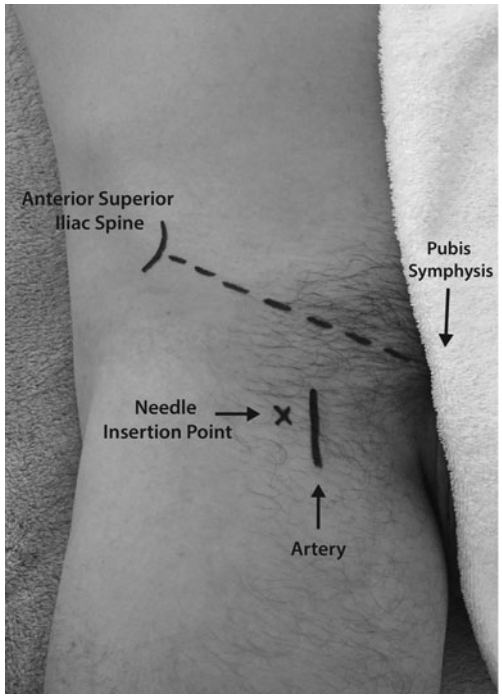

Figure 2. Femoral nerve block landmarks.

to the probe, inferior to the inguinal ligament and guided beneath the fascia iliaca. After negative aspiration, 30–40 ml of local anesthetic is injected in 5-ml increments with the same technique as described earlier. With correct needle placement under ultrasound guidance, the local anesthetic is spread in medial and lateral directions under the fascia iliaca (Jeng & Rosenblatt, 2018). The clinician should anticipate the distribution of anesthesia to the anterior and medial thigh down to the knee, as well as a section of skin on the medial leg and foot, which is the saphenous nerve (New York School of Regional Anesthesia, 2019). Figure 3 illustrates an ultrasound-guided view of FICB.

In the absence of ultrasound guidance, practitioners can use the landmark approach. As with the ultrasound-guided approach, the practitioner should visualize a line between the anterior superior iliac spine and the pubic tubercle. This line is trisected. At the border between the lateral and middle thirds, a blunt needle is inserted and directed cephalad at a 45° angle. As the needle is advanced, the practitioner should feel two distinct pops as the needle goes through the fascia lata and then the fascia iliaca. After negative aspiration, 30–40 ml of local anesthetic is injected in 5-ml increments, with gentle aspiration between

Figure 3. Ultrasound-guided right fascia iliaca compartment block.

injections (Jeng & Rosenblatt, 2018). Figure 4 illustrates the anatomical landmarks for FICB.

Ultrasound-Guided Approach

The ultrasound-guided approach is preferred in both FNB and FICB because it allows real-time visualization of nerves, surrounding structures, and the needle tip to maximize block success and minimize complications (Gray & Yap, 2018). The ultrasound technique allows the practitioner to monitor the appropriate spread of local anesthetic and make appropriate adjustments (New York School of Regional Anesthesia, 2018). More importantly, ultrasound-guided regional anesthesia significantly reduces the incidence of local anesthetic systemic toxicity by up to 65% (Kumar, Pyati & Wahal, 2018). As a benefit, ultrasound equipment is portable and carries no risk of ionizing radiation (Gray & Yap, 2018).

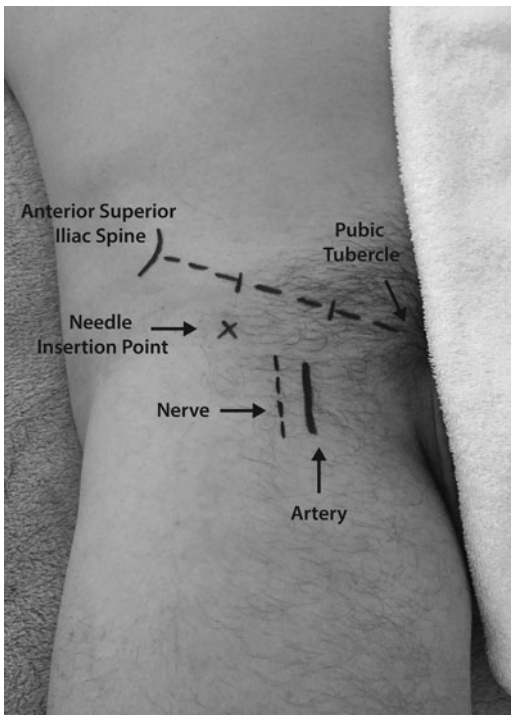

Figure 4. Fascia iliaca compartment block landmark approach.

Equipment

The patient needs to be in the supine position for both techniques. Make sure that all the proper equipment needed for the procedure is available. This entails a portable ultrasound machine and its transducer, sterile ultrasound cover sheath, ultrasound gel, antiseptic solution, sterile gloves, local anesthesia drawn up in a sterile syringe, and a Tuohy 18- to 20-gauge 5-cm long blunt tip needle. A cadaver study demonstrated that no fascicles were injured by blunt-tip needles whereas 3.2% were damaged by sharp-tip needles. In addition, an intrafascicular injection is rare and difficult to accomplish with blunt-tip needles even with an intraneural injection (Kumar & Prakash, 2018).

Choosing Local Anesthesia Agents

Local anesthetic agents can be grouped into two chemically distinct classes: esters and amides (Tobias, 2011). The amino amide class is used when performing FNB and FICB. This class consists of lidocaine, bupivacaine, mepivacaine, prilocaine, levobupivacaine, and ropivacaine. These anesthetic agents block sodium channels in the nerve membrane, preventing depolarization (Tobias, 2011). The choice of which local anesthetic to use is based on the practitioner's desired effects. Table 1 illustrates the variety of anesthesia used for PNBs and their appropriate onset, duration, and maximum dose. Local anesthetic toxicity may be observed in organs of the body that rely upon sodium channels for proper functioning. These most prominently include the CNS and the heart (Gadsden, 2018). Current guidelines recommend intravenous infusion of lipid emulsions to reverse local anesthetic toxicity (Kapitanyan, 2018). A bolus administration (1.5 ml/kg) of Intralipid 20% over 1 min should be initiated if signs of systemic toxicity arise. This is followed by an infusion (0.25 ml/kg/min) of Intralipid 20%, which should be continuously infused for at least 10 min after hemodynamic stability is achieved. If hemodynamic stability is not achieved, a maximum of two repeated

Table 1. Anesthetics onset, duration, and maximum dose

Anesthesia	Onset (min)	Duration of Analgesia (hr)	Max dose (mg/kg)[a]
2% Lidocaine (+Epi)	10–20	3–8	4.5
1.5% Mepivacaine (+HCO_3)	10–20	3–5	4.5
0.5% Ropivacaine	15–30	5–12	3
0.5% Bupivacaine (+Epi)	15–30	6–30	3

Note. From "Regional Anesthesia for Trauma Outside of Operating Theatre," by J. Choi, E. Lin, and J. Gadsden, 2013, *Anesthesiology, 26*(4), pp. 395–500. doi:10.1097/ACO.obo13e3283625ce3.
[a]From *Local Anesthetics: Systemic Toxicity*, by Open Anesthesia, 2018. Retrieved from https://www.openanesthesia.org/local_anesthetics_systemic_toxicity

boluses of Intralipid 20% is advised (Hong, Lee, Ok, & Sohn, 2018).

CONCLUSION

The use of FNB or FICB is an easy, effective, and safe alternative approach to acute pain management for patients with PFFs. These PNBs rapidly alleviate acute pain with minimal or no adverse effects, and they also lead to superior patient care by improving satisfaction and decreasing hospital length of stay. The ultrasound-guided approach allows the provider to visualize landmarks in real-time, improves first-time pass success, and reduces potential complications.

If the patient in the aforementioned scenario received FNB or FICB instead of systemic opioids, her respiratory depression that led to emergent intubation and an ICU admission would have been prevented. Providing patients with this alternative technique benefits the patients and the providers by resulting in a more optimal patient outcome. As providers, it is important to continue advocating for our patients and strive for the best quality of care.

REFERENCES

Abou-Setta, A. M., Beaupre, L. A., Rashiq, S., Dryden, D. M., Hamm, M. P., Sadowski, C. A., . . . Jones, C. A. (2011). Comparative effectiveness of pain management interventions for hip fracture: A systematic review. *Annals of Internal Medicine*, *155*(4), 234–245. doi:10.7326/0003-4819-155-4-201108160-00346

Adhikari, S., Amini, R., Kartchner, J., & Nagdev, A. (2015). Ultrasound-guided nerve blocks in emergency medicine practice. *The Multidisciplinary Medical Journal*, *35*(4), 731–736. doi:10.7863/ultra.15.05095

Beaudoin, F., Becker, B., Merchant, R., & Nagdev, A. (2010). Ultrasound-guided femoral nerve blocks in elderly patients with hip fractures. *The American Journal of Emergency Medicine*, *28*(1), 76–81. doi:10.1016/j.ajem.2008.09.015

Bhoi, S., Chandra, A., & Galwankar, S. (2010). Ultrasound-guided nerve blocks in the emergency department. *Journal of Emergencies, Trauma, and Shock*, *3*(1), 82–88. doi:10.4103/0974-2700.58655

Bleckner, L., & Buckenmaier, C. (2009). Femoral nerve block. In L. Bleckner, & C. Buckenmaier (Eds.), *Military advanced regional anesthesia and analgesia handbook* (pp. 53–55). Washington, DC: TMM Publications, Office of the Surgeon General. Retrieved from https://www.dvcipm.org/site/assets/files/1083/chapt15.pdf

Buck, F., Devroe, S., Missant, C., & Van de Velde, M. (2012). Regional anesthesia outside the operating room: Indications and techniques. *Anesthesiology*, *25*(4), 501–507. doi:10.1097/ACO.0b013e3283556f58

Chang, A., & White, B. (2017). *Peripheral nerve blocks*. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK459210

Chin, K., El-Boghdadly, K., & Pawa, A. (2018). Local anesthetic systemic toxicity: Current perspectives. *Local and Regional Anesthesia*, *11*, 35–44. doi:10.2147/LRA.S154512

Choi, J., Lin, E., & Gadsden, J. (2013). Regional anesthesia for trauma outside of operating theatre. *Anesthesiology*, *26*(4), 395–500. doi:10.1097/ACO.0b013e3283625ce3

Columbia University Department of Neurology. (2015). *Nerve blocks*. Retrieved from http://columbianeurology.org/neurology/staywell/document.php?id=41937

Cross, K., & Warkentine, F. (2016). Ultrasound-guided femoral nerve blocks in the initial emergency department management of pediatric femur fractures. *Clinical Pediatric Emergency Medicine*, *17*(1), 67–73. doi:10.1016/j.cpem.2016.01.004

Davenport, M. (2016). Hip fracture in emergency medicine. *Medscape*. Retrieved from https://emedicine.medscape.com/article/825363-overview

Faux, S., Scurrah, A., Shiner, C., & Stevens, J. (2018). Regional nerve blockade for early analgesic management of elderly patients with hip fractures—A narrative review. *Anaesthesia*, *73*(6), 769–783. doi:10.1111/anae.14178

Gadsden, J. (2018). *Local anesthetics: Clinical pharmacology and rational selection*. New York, NY: School of Regional Anesthesia. Retrieved from https://www.nysora.com/local-anesthetics-clinical-pharmacology-and-rational-selection

Gadsden, J., & Warlick, A. (2015). Regional anesthesia for the trauma patient: Improving patient outcomes. *Local and Regional Anesthesia*, *8*, 45–55. doi:10.2147/LRA.S55322

Goudie, A., Nagree, Y., Cooper, A., Watson, P., & Arendts, G. (2018). Ultrasound-guided femoral nerve blocks are not superior to ultrasound-guided fascia iliaca blocks for fractured neck of femur. *Emergency Medicine Australasia*, 1–6. doi:10.1111/1742-6723.13172

Gray, A., & Yap, E. (2018). Ultrasound for peripheral nerve blocks. *UpToDate*. Retrieved from https://www-uptodate-com.mimas.calstatela.edu/contents/ultrasound-for-peripheral-nerve-blocks?source=history_widget

Griffiths, R., Guay, J., Kopp, S., & Parker, M. (2018). Peripheral nerve blocks for hip fractures: A Cochrane review. *Anesthesia & Analgesia*, *126*(5), 1695–1704. doi:10.1213/ANE.0000000000002489

Grigg, L., Obideyi, A., Randall, A., & Srikantharajah, I. (2008). Nurse administered fascia iliaca compartment block for pre-operative pain relief in adult fractured neck of femur. *Acute Pain*, *10*(3–4), 145–149. doi:10.1016/j.acpain.2008.05.014

Holroyd-Leduc, J., Ospina, M., & Riddell, M. (2015). Use of femoral nerve blocks to manage hip fracture pain among older adults in the emergency department: A systematic review. *Canadian Journal of Emergency Medicine*, *18*(4), 245–252. doi:10.1017/cem.2015.94

Hong, J., Lee, S., Ok, S., & Sohn, J. (2018). Lipid emulsion for treating local anesthetic systemic toxicity. *Internal Journal of Medical Sciences*, *15*(7), 713–722. doi:10.7150/ijms.22643

Jeng, C., & Rosenblatt, M. (2018). Overview of peripheral nerve blocks. UpToDate. Retrieved from https://www-uptodate-com.mimas.calstatela.edu/contents/overview-of-peripheral-nerve-blocks?source=history_widget

Kapitanyan, R. (2018). Local anesthetic toxicity treatment & management. Medscape. Retrieved from https://emedicine.medscape.com/article/1844551-treatment

Kumar, A., & Prakash, S. (2018). Needle tip and peripheral nerve blocks. *Journal of Anaesthesiology Clinical Pharmacology*, *34*(1), 129–130. doi:10.4103/0970-9185.227375

Kumar, A., Pyati, S., & Wahal, C. (2018). Advances in regional anaesthesia: A review of current practice, newer techniques and outcomes. *Indian Journal of Anaesthesia*, *62*(2), 94–102. doi:10.4103/ija.IJA_433_17

LaPietra, A., Motov, S., & Rosenberg, M. (2016). *Alternatives to opioids for acute pain management in the emergency department: Part II*. Retrieve from https://www.reliasmedia.com/articles/138951-alternatives-to-opioids-for-acute-pain-management-in-the-emergency-department-part-ii

Lollo, L., Grabinsky, A., & Wu, J. (2011). Regional anesthesia in trauma medicine. *Anesthesiology Research and Practice*, *2011*, 7. doi:10.1155/2011/713281

Mallin, M., & Nagdev, A. (2010). *Femoral nerve block*. Retrieved from http://www.ucdenver.edu/academics/colleges/medicalschool/departments/EmergencyMedicine/Sections/ultrasound/education/Documents/Chapter%205%20Femoral%20Nerve%20Block(2).pdf

New York School of Regional Anesthesia. (2018). *Ultrasound-guided femoral nerve block*. Retrieved from https://www.nysora.com/ultrasound-guided-femoral-nerve-block

New York School of Regional Anesthesia. (2019). *Ultrasound-guided femoral nerve block.* Retrieved from https://www.nysora.com/techniques/lower-extremity/ultrasound-guided-femoral-nerve-block

Open Anesthesia. (2018). *Local anesthetics: Systemic toxicity*. Retrieved from https://www.openanesthesia.org/local_anesthetics_systemic_toxicity

Pageau, P., Perry, J., Ritcey, B., & Woo, M. (2016). Regional nerve blocks for hip and femoral neck fractures in the emergency department: A systematic review. *Canadian Journal of Emergency Medicine*, *18*(1), 37–47. doi: 10.1017/cem.2015.75

Samet, R., & Slade, I. (2018). Regional anesthesia and analgesia for acute trauma patients. *Anesthesiology*, *36*(3), 421–454. doi:10.1016/j.anclin.2018.04.004

Sanzone, A. G. (2016). Current challenges in pain management in hip fracture patients. *Journal of Orthopaedic Trauma*, *30*(Suppl. 1), S1–S5. doi:10.1097/BOT.0000000000000562

Tobias, J. (2011). Anesthesia principles and operating room anesthesia regimens. *Pediatric Critical Care*. Retrieved from https://www.sciencedirect.com/topics/medicine-and-dentistry/local-anesthetic-agent

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