Care of the Patient With a Peripheral Nerve Block

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Long-acting peripheral nerve blocks provide effective postoperative pain management, but there are risks associated with rendering an extremity insensate. Perianesthesia nurses play a major role in anticipating and mitigating risks and carefully monitoring patients for potential complications. This article presents uncommon but important considerations related to the care of patients with a peripheral nerve block. These include compartment syndrome, local anesthetic systemic toxicity, thermal injuries, falls, and fractures as well as their management and prevention. The nurse's responsibility in discharge education after a peripheral nerve block is also discussed.

Keywords: *peripheral nerve block, regional anesthesia, patient safety, discharge education.*
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OBJECTIVES—EXPLAIN THE PATHOLOGY, prevention, and management of local anesthetic systemic toxicity (LAST), compartment syndrome, and other uncommon complications of peripheral nerve blocks; identify risk factors and methods to prevent falls in orthopaedic patients with lower extremity nerve blocks; and describe discharge planning and education in patients with peripheral nerve blocks.

Long-acting peripheral nerve blocks, single-injection blocks, or continuous catheter techniques provide effective target-specific postoperative pain relief. This reduces the need for opioid pain medication and opioid-related side effects and improves the quality of postoperative recovery in terms of pain-related sleep disruption and greater patient satisfaction.[1-3] Despite these benefits, there is inherent risk associated with rendering an extremity insensate for hours to days. A survey of the Society for Ambulatory Anesthesia reveals that some anesthesia professionals refuse to discharge patients with long-acting peripheral nerve blocks because of their concerns for patient injury and the inability of patients to care for themselves at home[4] despite a low risk of postoperative neurologic

complications and patient injuries.[3] Perianesthesia nurses may play a major role in anticipating and mitigating potential risks and carefully monitoring patients for complications.[5]

Pain can be a protective mechanism that provides humans with the ability to sense danger and avoid further injury. The reduction or elimination of sensory input through peripheral nerve blockade, although well intended for pain control, impairs this protective mechanism. Management of the patient with a peripheral nerve block should involve deliberate protection of the affected extremity, specific patient education regarding nerve block characteristics and potential complications,[6] and a careful system for follow-up to allow early identification of potential problems and immediate intervention at the first sign of complications. This article will address particular issues involved in the clinical care of the patient with a peripheral nerve block, focusing on nursing strategies for preventing complications and educating patients to maximize the benefits.

Preoperative Preparation

The decision to perform a single-injection peripheral nerve block versus a catheter-based technique for a continuous local anesthetic infusion will be determined by several factors, including the expected severity and duration of postoperative pain and the patient's personal preference. If catheter placement is under consideration, an assessment should be made of the patient's ability to comply with the treatment plan, availability of a caretaker at home when discharged, safety of the discharge location, and the ability to contact the patient for follow-up phone calls.[6] Before proceeding with any regional anesthetic technique, a complete neurologic examination should be performed, and any pre-existing sensory or motor deficits should be documented.[5] This information should be available for the anesthesia professionals and nurses providing postoperative care because it is important to differentiate a new deficit from a pre-existing condition.

Uncommon But Serious Complications

Local Anesthetic Systemic Toxicity (LAST)

LAST, the most dreaded complication of regional anesthesia, has been reported in patients receiving single-injection peripheral nerve blocks as well as continuous peripheral and neuraxial local anesthetic infusions.[7] LAST occurs due to excessive vascular uptake of local anesthetic. The incidence is rare,[8] but patients and health care professionals should be appropriately educated so they can identify early symptoms, including perioral numbness and tingling, metallic taste, and tinnitus. These can sometimes rapidly progress from mild auditory and visual disturbances to agitation, stupor, coma, seizures, cardiovascular collapse, and arrest.[9] Onset of symptoms typically occurs between 1 and 5 minutes after local anesthetic injection but may be delayed more than 15 minutes.[10] LAST should be considered in any patient with mental status changes or neurologic or cardiovascular symptoms after a nerve block.

If the patient develops cardiovascular collapse from LAST, advanced cardiac life support (ACLS) should be instituted immediately. Lipid infusion has been shown in both animal studies and in case reports to effectively reverse the cardiotoxic effects of local anesthetics.[11] The lipid infusion (20% lipid emulsion) may help decrease the concentration of local anesthetic in the tissues or may directly affect cells by helping to reverse the toxicity at the myocyte.[12] Lipid emulsion, resuscitation equipment, and a LAST treatment algorithm should be immediately available wherever peripheral nerve blocks are performed.[13] Table 1 lists common signs and symptoms of LAST and general principles for treatment.

Risk reduction is the best tool for LAST management. Intravascular levels of local anesthetic are influenced by dose and site of injection. Local anesthetic dose should be limited to the minimal volume and concentration required to achieve the desired block. Systemic absorption of local anesthetic is greater in highly vascularized regions, such as the brachial plexus. The rate of vascular uptake may be reduced by the addition of vasoconstrictors. Pathologic risk factors to consider include liver dysfunction, advanced age, cardiac dysfunction, and conduction abnormalities.[10]

Table 1. Signs, Symptoms, and Management of LAST

Neurologic	Cardiovascular
Auditory/visual changes	Ventricular tachycardia
Perioral numbness/tingling	Ventricular fibrillation
Metallic taste	Torsades de pointes
Sedation	Prolonged PR interval on EKG
Lightheadedness	Complete heart block
Slurred speech	Ventricular ectopy
Restlessness/agitation	Bundle branch block
Myoclonus	Bradycardia
Seizures	Hypotension
Coma	Asystole

Management*
Airway management
Ventilate with 100% oxygen
Seizure suppression
Benzodiazepines preferred
ACLS
Avoid vasopressin, calcium channel blockers, beta blockers, and local anesthetics
Reduce epinephrine dose to < 1 mcg/kg
Lipid emulsion (20%)
Bolus 1.5 mL/kg (lean body mass) intravenously over a duration of 1 min
Continuous infusion 0.25 mL/kg/min
Maximum 10 mL/kg during the first 30 min
Disposition
Facility with cardiopulmonary bypass capability

LAST, local anesthetic systemic toxicity; EKG, electrocardiogram; ACLS, advanced cardiac life support.
*Adapted from https://www.asra.com/content/documents/asra_last_checklist.2011.pdf.

Compartment Syndrome

Although unproven, a common fear among physicians and nurses is that a regional anesthetic may mask and thus delay the diagnosis and treatment of compartment syndrome.[14] Compartment syndrome is a condition in which swelling within a myofascial compartment causes compartment pressure to rise above capillary perfusion pressure, impairing circulation and eventually resulting in tissue necrosis from hypoxia. Catastrophic complications result if the treatment (fasciotomy) is delayed for more than 12 hours.[15] Compartment syndrome occurs most commonly in tibial shaft fractures, particularly proximal fractures, because of greater muscle mass compared with the ankle and diaphyseal fractures of the forearm.[16] Compartment syndrome is assessed by using the five Ps: pallor, pulselessness, paralysis, paresthesia, and pain. Pulselessness and paralysis are rare and present after prolonged tissue injury.[17] As the syndrome progresses, sensory loss can occur.[18] Worsening pain over time is a hallmark symptom of compartment syndrome, especially when associated with passive stretching. Capillary refill may also be prolonged (greater than 3 seconds) in patients with compartment syndrome.

Potentially, any analgesic modality can affect the detection of compartment syndrome if pain is used as the sole presenting sign.[19] There are few case reports that peripheral nerve blocks have delayed the diagnosis of compartment syndrome in both upper and lower extremity surgery.[20-22] Frequent assessment and monitoring for increasing pain, especially when associated with passive stretching, as well as using a dose of local anesthetic that allows for motor and some sensory preservation can help reduce the risk of obscuring this catastrophic complication. Compartment syndrome should be suspected in at-risk patients with new onset breakthrough

pain or progressive numbness outside the expected distribution of the nerve block. Most importantly, nurses involved in the care of patients at risk for compartment syndrome must maintain a high index of suspicion.

Cast and splint application that is too tight can result in a form of compartment syndrome with signs and symptoms similar to classic compartment syndrome. The major difference in cast- or splint-related compartment syndrome is that pain improves with loosening of the cast or splint; however, close follow-up is still warranted because swelling may continue to progress to the point of requiring fasciotomy. If an adjustment or removal of the cast or splint becomes necessary, the surgeon should be informed although the anesthesia professionals or nurses present may need to act quickly. Prudent management of these patients requires open and clear communication among all members of the health care team.

Patient Safety Strategies

Extremity Protection

Loss of motor and sensory function after a peripheral nerve block will require special precautions to protect the extremity. Skin integrity should be monitored as well as any pressure points from the cast or splint. Use of heat or ice can potentially result in thermal injury, when combined with a dense sensory block, if directly applied to the skin. The use of a supportive sling for patients with upper extremity blocks, at least until proximal motor block resolves, and crutches for patients with lower extremity blocks are recommended.[23,24] Inadvertent trauma to an insensate extremity, most commonly related to falls, can result in additional injuries that may be masked with regional anesthesia. Saporito et al[25] reported a case of a postoperative styloid fracture of the fifth metatarsal after a patient stumbled on postoperative day 2. The patient had a functional popliteal-sciatic nerve block and only discovered the fracture when she developed pain in the lateral foot after the catheter was removed.[25]

It is essential to communicate with the surgeon regarding the patient's expected postoperative weight-bearing status and disposition. For example, a patient undergoing operative knee arthroscopy may not be immobilized postoperatively, and the surgeon may discharge the patient to home with instructions to bear weight as tolerated; the same patient, if he or she receives long-acting lower extremity peripheral nerve blocks, should be strictly non–weight-bearing until the blocks resolve. Pain or numbness in an area or distribution that is not expected from the operation or regional anesthetic should alert the health care provider to the possibility of an occult injury and should be evaluated.

Prevention of Falls

In inpatient settings, falls are a common cause of adverse events, potentially leading to physical injuries, psychological harm, prolonged hospital stays, increased cost of care, and potential legal liability.[26-30] Although there are numerous factors that contribute to a fall, patients with lower extremity peripheral nerve blocks should be considered at increased risk for falling, especially after surgery like total joint arthroplasty.[19,31] In the postoperative period, orthopaedic procedures often lead to impaired mobility, and peripheral nerve blocks, although effective in managing postoperative pain, can result in muscle weakness that is associated with higher risk for falling.[32]

Risk Factors for Falls

Patients undergoing major lower extremity orthopaedic surgery can be presumed to have decreases in strength, proprioception, and range of motion in the immediate postoperative period. In two retrospective studies, one at a single orthopaedic inpatient unit and the other in an orthopaedic specialty hospital, total knee arthroplasty was the procedure most commonly associated with falls, and total hip replacement increased the risk of having a serious fall-related injury by nearly four fold.[33,34]

Other identified risk factors include advanced age, revision surgery, and the presence of comorbid organ diseases.[34-36] Up to 64% of falls can be attributed to toileting, with these falls occurring while going to, inside, or coming from the bathroom or using the bedside commode.[33,34] Most inpatient falls occur during night shift.[33,37] The use of opioids for postoperative pain management may also increase fall risk.[33] Sedative

medications that affect the central nervous system such as benzodiazepines and sleep aids may also contribute to fall risk by themselves, or in combination with other medications.[38]

The use of certain regional anesthesia techniques for postoperative analgesia among orthopaedic surgical patients may increase the risk of falls. Motor and sensory deficits produced by nerve blockade may contribute to muscle weakness and instability. In particular, femoral nerve blocks have been implicated in patient falls.[35,39] Subsequently, adductor canal blocks are commonly used as an alternative to femoral nerve blocks for total knee arthroplasty. The use of the more selective adductor canal block technique, when compared with a femoral nerve block, has been shown to provide comparable pain management while better preserving quadriceps strength and balance.[40,41]

Fall Prevention Strategies

In this section, attention will be given to the review of inpatient fall prevention programs on orthopaedic wards in acute hospital settings, although fall prevention is equally important for ambulatory surgery patients.[42] The Joint Commission outlines the expected elements that should be included in a fall reduction program (Table 2).

Table 2. Elements of Performance for National Patient Safety Goal 09.02.01 (Fall Reduction)*

1. Assess every patient's risk for falls
2. Implement specific interventions targeted at reducing falls based on each patient's assessed level of risk
3. Provide staff education on your fall reduction program at appropriate time intervals determined by your institution
4. Provide education to patients and families/caregivers on any individualized fall reduction strategies
5. The effectiveness of all fall reduction activities (eg, assessment, interventions, and education) must be evaluated regularly. Outcome indicators for evaluation may include number of falls and number and severity of fall-related injuries during a given period

*Adapted from https://www.jointcommission.org/assets/1/6/NPSG_Chapter_OME_Jan2017.pdf.

A common element among prevention programs that have reduced their fall incidence is having a fall risk assessment tool. Although several assessment tools exist, the Morse Fall Scale is most often used.[43] The Morse Fall Scale focuses on six fall risk variables (history of falls, the presence of secondary diagnosis, ambulatory aid needs, intravenous therapy, gait characteristics, and mental status) that result in a composite score to identify risk factors and potential specific interventions. Before widespread implementation of a fall prevention program, assessment tools should be piloted within a target group to ensure feasibility and adherence among hospital staff.[44] Patients identified as being a high fall risk may have alerts placed in the electronic medical record to facilitate communication with other health care professionals.[45]

Another intervention that is frequently incorporated into inpatient fall prevention strategies is patient education.[46] Fall prevention education should include orientation to the inpatient room, call bell system, and use of nonslip socks. Because most falls occur during bathroom transfers, patients should be reminded regularly to request assistance going to and from the bathroom or commode. Furthermore, the patient with a peripheral nerve block requires education about nerve block–induced weakness and impairment of proprioception and balance. Ideally, fall reduction education should begin during the preoperative surgery visit[47] and on the day of surgery before administering sedation and placing the peripheral nerve block.[48] The inclusion of caretakers will reinforce salient points. An education form may be used as a visual aid and signed by the patient and clinician after the education session.[48] The form serves as an accountability tool, requiring the patient to do his or her part to prevent falls. Fall education should continue in the postoperative recovery area and throughout the patient's hospital stay.

Some of the other commonly used interventions for fall prevention include bedside visual aids (Figures 1A and 1B), wristbands, postfall reviews, nonslip footwear, bed alarms, toileting schedules, hourly rounds, medication reviews, and environment modifications.[43,46] Nursing knowledge of

Figure 1. Fall prevention visual aids that may be posted in patients' rooms. This figure is available in color online at www.jopan.org.

peripheral nerve block anatomy and physiology is also integral in the prevention of falls and understanding a patient's activity limitations. For instance, the continuous femoral nerve block infusion may be paused very early in the morning to allow block resolution and return of quadriceps strength before physical and occupational therapy. An informed nurse should advocate for a daily scheduled pause in the perineural infusion if a patient is ambulating with a femoral nerve block catheter. Annual peripheral nerve block competencies would likely improve nursing knowledge and promote patient safety.

Discharge Planning and Patient Education

Ideal discharge instructions are clear, concise, easy to understand, and address the most likely issues that will arise for patients so that they feel comfortable with their treatment plan. In addition, the patient should understand when and how to contact the anesthesia professional if serious complications arise. Because the patient will most likely have received some other form of anesthesia or sedation during surgery, care must be taken to ensure that the patient education and discharge instructions are clear and understood. Providing both written and verbal instructions to the patient and caretaker before and after surgery can improve understanding of what to expect and what to look for in the postoperative period (Figures 2A and 2B).[4] The teach-back method has been shown to improve patient comprehension of discharge instructions.[49] This method involves the patient explaining and demonstrating new skills to the educator after listening to instructions, allowing the educator to correct misunderstood information.

The patient should be warned of the potential risk of injury secondary to having an insensate extremity and how to minimize this risk, as previously discussed. The patient should be advised when he or she should expect the initial dense anesthetic block to recede and anticipate the need for additional systemic pain medication before block resolution (for single-injection blocks) or transition to less dense sensory block (for continuous peripheral nerve blocks).

For patients receiving a continuous infusion of local anesthetic on an ambulatory basis, use of devices that give them the ability to temporarily pause the infusion or reduce the infusion rate when they self-report excessive numbness or prolonged initial anesthetic block are recommended. The patient's ability to perform these functions should be demonstrated before discharge from the hospital. Reviewing nonpharmacologic interventions such as elevation and proper heat and ice therapy (not directly to exposed skin and not for prolonged periods) should be included

A

Removing your nerve block catheter:

- Since there are no stitches, removal is easy by you or your caretaker.
- Follow the pump tubing to the edge of the dressing then peel off the entire dressing to expose the catheter.
- When exposed, grasp the catheter close to the skin and pull until all of it comes out. You can expect to remove up to 10-15 cm of catheter.

- Inspect the tip of the catheter, and check to make sure that the end is blue, black, or silver; then you can dispose of the catheter in the trash.
- You do **not** need to cover the site after the catheter is removed.
- If you have any difficulty removing the catheter, please call the Regional Anesthesia Doctor.
- Your pump and catheter are all disposable, so please dispose of it as follows: ___.

To contact a REGIONAL ANESTHESIA DOCTOR ON CALL at any time day or night: (123) 456-7890

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Continuous Nerve Block Catheter Instructions

Insert Image of Infusion Device Here

- You have had a nerve block catheter placed for pain control after surgery.
- It is **normal** for your fingers/toes to feel numb until the morning after surgery.
- A health-care provider will call you every day for follow-up.

When you have pain:

- Push the **middle** blue button and wait 15 minutes for the effect.
- If you still have pain after 15 minutes, take 1-2 pain pills prescribed by your surgeon.
- The bolus button will work only one time every __ minutes, so you cannot mistakenly give yourself too much medicine.
- You do not have to push the button if your pain is well-controlled.

B

If your fingers/toes become completely numb:

- Turn off your pump to stop the infusion by ___ (see figure below).
- Later in the day/night, when you can feel someone else touching all of your fingers/toes, turn the pump back on by ___.
- The pump should start up again. When the local anesthetic (numbing medicine) is running again, you may start to notice tingling in your fingers/toes within the hour.
- If your pump is off for more than 3 hours, and you still cannot feel one or more of your fingers/toes, call the Regional Anesthesia Doctor on call.

Insert Image of Infusion Device Here

It is <u>normal</u> to still have pain with a nerve block catheter:

- The medicine in the pump is weaker than the first injection.
- This is done on purpose so you can move your leg/arm.

Other Instructions:

- You **<u>must not drive</u>** or operate potentially dangerous machinery while your catheter is in place.
- Please keep your sling and/or splint on unless doing physical therapy.
- Very rarely, the catheter may fall out. If this occurs, take 1-2 of your pain pills, turn off the infusion pump using the instructions above, and call the Regional Anesthesia Doctor.
- It is **normal** for fluid to leak from the catheter site. You can use a towel to absorb the extra fluid.
- Do **not** get the catheter, pump, or your bandages wet.
- If you have had a nerve block for surgery on your leg or foot, **<u>do not stand or walk using the affected leg</u>** until your strength comes back.
- Ask for help when getting up and moving around to avoid falling.

If you notice any of the symptoms listed below, <u>STOP</u> the infusion pump and immediately call the Regional Anesthesia Doctor:

- Rash or hives
- Numbness around the mouth
- Metallic taste
- Ringing in the ears
- Lightheadedness
- Nervousness
- Confusion
- Chest pain
- Twitching
- Convulsions / Seizures

If your pump malfunctions or stops working:

- Pump not getting smaller, and no numbness or tingling in fingers/toes.
- Call the Regional Anesthesia Doctor.

Figure 2. Sample patient and caregiver education handout for continuous peripheral nerve block. This figure is available in color online at www.jopan.org.

in the postoperative management discussion. If the patient is at any risk for compartment syndrome in the hospital or at home, clear instructions should be given on contacting a health care provider directly in the event of persistent motor or dense sensory block or pain that continues to increase over time, especially if it is outside the distribution of the block or disproportionate to the initial postoperative pain. These patients should also be shown how to check pulses and capillary refill in the distal portion of their affected extremities.

For patients with perineural catheters, informing the patient on how to keep the catheter site clean and dressed as well as how to monitor for signs of site infection are important, especially if the duration of therapy will be longer than 2 days. Leakage of local anesthetic from the catheter insertion site is not uncommon, and the patient should be informed that this may be expected.[31] Often patients report leakage because of concerns that they are not receiving the local anesthetic medication or that they may be bleeding when the draining infusate solution is pink colored. Assuming that the catheter has not been inadvertently dislodged, these patients should be reassured that the amount of medication they are receiving is sufficient, that leakage is normal, and that the infusate solution assumes this color because of mixing with body tissues. It is reasonable to send patients home with additional dressing supplies in the event that reinforcement because of leakage becomes necessary.

Finally, daily evaluation by phone for outpatients should be accomplished for the duration of the peripheral nerve block therapy.[6] The patient or caregiver should be able to reach an anesthesia professional 24 hours a day, and the acute pain service should have a primary contact number for each patient and ideally a back-up contact (eg, caregiver).

Conclusion

Peripheral nerve blocks are highly effective pain management techniques in both hospitalized and ambulatory postoperative patients. The risks associated with using these techniques may be mitigated by informed and prudent perianesthesia nurses. The topics presented in this review article should provide perianesthesia nurses with the knowledge and confidence to effectively collaborate with anesthesia professionals in the care of ambulatory patients and inpatients with peripheral nerve blocks.

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Care of the Patient with a Peripheral Nerve Block

Article Objectives

1. Explain the pathology, prevention and management of local anesthetic system toxicity, compartment syndrome and other uncommon complications of peripheral nerve blocks
2. Identify risk factors and methods to prevent falls in orthopedic patients with lower extremity nerve blocks
3. Describe discharge planning and education in patients with peripheral nerve blocks

Outcome of this CNE Activity

To enable the nurse to increase knowledge on care of the patient with a peripheral nerve block

Target Audience

All perianesthesia nurses.

Accreditation

American Society of Perianesthesia Nurses is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

Additional provider numbers: Alabama #ABNP0074, California #CEP5197

Registered nurse participants can receive 2.0 contact hours for this activity.

Disclosure

All planners and authors of continuing nursing education activities are required to disclose any significant financial relationships with the manufacturer(s) of any commercial products, goods or services. Any conflicts of interest must be resolved prior to the development of the educational activity. Such disclosures are included below.

Planners and Author Disclosures

The members of the planning committee for this continuing nursing education activity do not have any financial arrangements, interests or affiliations related to the subject matter of this continuing education activity to disclose.

The authors for this continuing nursing education activity do not have any financial arrangements, interests or affiliations related to the subject matter of this continuing nursing education activity to disclose.

Verification of Participation: Verification of your participation in this educational activity is done by having you go to the ASPAN website: (1) select the article, (2) complete the registration form and payment

Requirements for Successful Completion : To receive contact hours for this continuing nursing education activity you must complete the registration form and payment, read the article, complete the online posttest and achieve a minimum grade of 80%, and complete the online evaluation.

Commercial Support / Unrestricted Educational Grant: No commercial support or unrestricted educational grant has been received for this educational activity.

Directions

A multiple-choice examination, designed to test your understanding of **Care of the Patient with a Peripheral Nerve Block** according to the objectives listed, is available on the ASPAN Website: https://www.aspan.org/Education/CE-Articles-Online/

To earn contact hours from the American Society of Perianesthesia Nurses (ASPAN) Continuing Nursing Education Accredited Provider Unit go to the ASPAN website: (1) select the article, complete the registration form and payment; (2) read the article; (3) complete the posttest on the ASPAN Website and achieve a minimum score of 80%; and (4) complete the online evaluation.

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Your certificate will be available for you to print upon successful completion of the activity and completion of the online evaluation.

Online payment is required: ASPAN member: $5.00 per test; nonmember: $15.00 per test.