Regional Anesthesia Techniques -
An Element of Multimodal Pain Management
Practice Considerations

Introduction

Regional anesthesia, defined by the American Society of Regional Anesthesia and Pain Medicine (ASRA), is a pain management technique where the patient is injected with an anesthetic near a cluster of nerves to numb the body area requiring surgery or an invasive procedure.\(^1\) Regional anesthesia techniques produce a loss of sensation and/or pain in a targeted body area by preventing the generation and conduction of a nerve impulse.\(^2\) This is achieved by injecting local anesthetics adjacent to a nerve, effectively decreasing the ion channels' permeability to sodium, thereby creating a conduction block.\(^2\) The duration of this effect can be increased by combining the local anesthetic with other medications.

These techniques have gained popularity for providing surgical and procedural anesthesia as they allow the patient to return to their preprocedural state more rapidly while minimizing or eliminating the need for opioid analgesics postoperatively.\(^2\) Patients who undergo surgical or invasive procedures experience improved recovery when the need for opioids is minimized or eliminated using opioid-sparing, multimodal pain management techniques that often include regional anesthesia.\(^3-7\) Despite advances in understanding and managing postoperative pain, research suggests that postoperative pain continues to be undertreated.\(^6,8,9\) To better care for patients, acute pain management teams in the perioperative setting have been established as anesthesia professionals make a concerted effort to support a faster recovery and improved patient satisfaction.

Pain management services are optimized when they are patient- and procedure-specific. Critical elements of patient-specific acute pain management services include patient engagement through shared education and planning to address the patient’s needs. This document is a companion to the American Association of Nurse Anesthesiology (AANA) Enhanced Recovery after Surgery.\(^3\)

Regional Anesthesia Background\(^2,10,11\)

Regional anesthesia techniques may include, but are not limited to, spinal, epidural, and peripheral nerve blocks, such as upper- and lower-extremity blocks and fascial plane blocks.
Local anesthetics can be used in various ways to create a conduction blockade, whether topical applications, local infiltration, peripheral nerve blockade, intravenous regional anesthesia, epidural anesthesia, or spinal (subarachnoid) anesthesia. Regional anesthesia techniques may be used alone or with other anesthetic techniques to provide anesthesia and analgesia for various surgical, obstetrical, diagnostic, and therapeutic procedures and chronic pain management. Local anesthetics may be administered by infiltration, single injection, or via a catheter for intermittent or continuous medication administration. Regional anesthesia, in combination with other anesthesia techniques, can minimize the side effects of an individual anesthetic technique, maximize benefits, and offer the patient pain management options.

Regional Anesthesia Benefits

Incorporating regional techniques for preemptive analgesia is associated with the following, which leads to an increase in patient satisfaction:

- Reduction in postoperative pain \(^{2,5,7,13-16}\)
- Improved pain scores \(^{2,5}\)
- Decreased incidence of postoperative nausea and vomiting \(^{2,17-20}\)
- Reduction or elimination of opioids postoperatively \(^{2,6,16,17,20,21}\)
- Reduction of pulmonary complications \(^{18}\)
- Shorter post-anesthesia care unit (PACU) stay \(^{18,22}\)
- Shorter time to discharge from the facility \(^{2,15,20}\)
- Earlier rehabilitation and mobilization \(^{15,19,21}\)
- Shorter time to resume normal activities \(^{18}\)
- Reduced intraoperative blood loss \(^{18,23}\)
- Reduced incidence of chronic postsurgical and postprocedural pain (defined as pain beyond three months after surgery), thus potentially decreasing the risk of prolonged opioid use \(^{24-26}\)

Regional anesthesia may also be preferred in patients with confirmed or suspected COVID-19 and other infectious respiratory viral diseases to avoid additional airway manipulation and opioid-induced ventilatory impairment \(^{27}\)

Settings

The use of regional anesthesia techniques is not limited to the hospital setting. Due to the clinical value of regional anesthesia techniques, they continue to be used safely and effectively...
in ambulatory\textsuperscript{20,22,28,29} and office-based settings.\textsuperscript{30,31} Polshin et al. conducted a retrospective cohort study analyzing peripheral nerve block use in the ambulatory setting and found support for peripheral nerve block use.\textsuperscript{22} The literature cited improved postoperative analgesia, opioid-sparing, and significantly reduced PACU length of stay.\textsuperscript{22} Ambulatory and office-based facilities must have appropriate policies, equipment, and staff present in the facility to maintain patient safety, provide appropriate monitoring, and address emergencies. For additional guidance, refer to the AANA Position Statement, \textit{Office Based Anesthesia}.\textsuperscript{32}

\textbf{CRNA Scope of Practice}

Core elements of nurse anesthesiology educational programs include regional anesthesia education and skill development. The Council on Accreditation of Nurse Anesthesia Educational Programs (COA) specifies the necessary didactic and clinical experience requirements to develop regional anesthesia core competencies.\textsuperscript{33} These core competencies are the foundation of the CRNA regional anesthesia scope of practice.\textsuperscript{34} The anesthesia professional engages in life-long learning to provide evidence-based care specific to practice and patient populations. As CRNAs refresh or integrate new technologies and techniques into their practice, they acquire and demonstrate the necessary knowledge, skills, and abilities for their practice.\textsuperscript{35}

\textbf{Considerations}

Regional anesthesia alone or as part of the perioperative multimodal pain management plan may be used in neonatal, pediatric, adult, and geriatric populations. Patient-specific circumstances and health status are considered part of the overall assessment and evaluation of the patient, which is used to develop a comprehensive plan for anesthesia care prior to the procedure through their discharge home.

\textit{Pediatric}

Many factors make the assessment of pain unique and challenging in the pediatric population.\textsuperscript{36} Age, cognitive, behavioral, and psychosocial factors influence the pediatric patient’s pain experience.\textsuperscript{37,38} It is important to engage the parent(s) or caregiver(s) as well as the patient in a discussion about the value of effective pain management to create a sense of safety for the patient. There are many valid age- and developmental-specific, as well as culturally appropriate, pain assessment tools available to assist with guiding the patient’s analgesic or alternative therapy needs.\textsuperscript{7,39,40} Initially, a combination of observational and self-report scales
may help to identify the best tool and engage the patient in self-assessment for optimal
management of discomfort. An observational pain scale has is most effective for children who
are younger than five years of age and those who are not able to self-report. After five years of
age, self-reported assessment of discomfort is effective.41,42

Regional anesthesia techniques used in combination with general anesthesia has a long history
of success for pediatric and other patients who may not be able to quantify or express their
discomfort. It is not uncommon for regional anesthesia to be performed for pediatric patients
under sedation or general anesthesia, which differs from adult patients who are typically awake
and responsive as regional anesthesia is performed.37,38 Ultrasound-guidance has increased
the efficacy and safety of epidural injections, peripheral nerve blocks, and other regional
anesthesia techniques for all patients and specifically for pediatric patients who receive regional
anesthesia under sedation or general anesthesia.7,37,38

Senior or Geriatric
Recovery after sedation or anesthesia may be delayed when the senior or geriatric patient
experiences a change in routine, environment, health status, or has limited social support
available.43 In addition to physical and sensory changes, the senior patient may experience
cognitive changes in the post-procedure period due to opioids, sedatives, interrupted sleep
patterns, and a change in routine and environment. These factors, together with the patient’s
comorbidities, coagulation status, and procedural requirements, must be assessed during the
evaluation of risks and benefits of the anesthetic technique. When appropriate, a regional
anesthesia technique used in combination with multimodal analgesics offers an effective option
to reduce the risk of postprocedural complications for the senior patient.23,44

Preexisting Conditions
Regional anesthesia may pose additional risks for patients with certain preexisting conditions.
Increased risk of nerve injury should be considered in patients with conditions such as diabetes,
multiple sclerosis, nutritional deficiencies, alcoholism, hypothyroidism, Guillain-Barre Syndrome,
ulnar neuropathy, carpal tunnel syndrome, vascular disease, proximal nerve root compression,
spinal canal stenosis, or previous physical injury or trauma.45-47 In addition, the patient should
be assessed for infection at the planned insertion or injection site of the local anesthetic, history
of headache or backache, anatomic anomalies, and local anesthetic allergy.
**Morbid Obesity**

The morbidly obese patient requires careful planning to mitigate challenges related to equipment, supplies, positioning, identification of landmarks, and prevention of unintentional catheter dislodgement. These factors may lead to complications and increase the incidence of block failure. The obese patient may also be at increased risk of obstructive sleep apnea. The diagnosis or identification of risk of obstructive sleep apnea may require additional perioperative assessment and planning. This population may benefit from the use of regional anesthesia as it has been associated with lower complication rates than general anesthesia in patients with obstructive sleep apnea due to the ability to minimize or eliminate opioids from the plan of care.

**Coagulation Status**

The history of recent venous thromboembolism and current or recent use of antithrombotic or thrombolytic therapy are contraindicated for regional anesthesia procedures and require additional considerations. Consultation with the patient’s primary or specialty care provider may be considered prior to proceeding with the use of a regional anesthesia technique.

Thromboprophylaxis management regimes vary. Patient-specific therapy and coagulation status should be considered and optimized prior to neuraxial needle placement and if a catheter was placed, assessed prior to catheter removal. ASRA’s Evidence-Based Guidelines, *Regional Anesthesia in the Patient Receiving Antithrombotic or Thrombolytic Therapy*, provide specific guidance regarding regional anesthesia administration for patients on thromboprophylactic therapy. To ensure you have the most current version of these guidelines, please visit the ASRA website.

**Patient Assessment and Evaluation**

Standard II of the *Standards for Nurse Anesthesia Practice* states that CRNAs “perform and document or verify documentation of an anesthesia-focused physical assessment to form the anesthesia plan of care.” The patient assessment and evaluation involve a review of the following: the patient’s medications; allergies; medical, surgical, and anesthetic history; psychosocial health; and issues related to respiratory, cardiovascular, renal, hepatic, gastrointestinal, neurologic, endocrine, musculoskeletal, and hematologic systems. During the pre-anesthesia assessment, health history and current status are reviewed and evaluated to develop the patient-specific perioperative plan of care.
Patient-Specific Perioperative Anesthesia Plan

Standard III of the *Standards for Nurse Anesthesia Practice* states that CRNAs “formulate a patient-specific plan for anesthesia care.” The patient’s expectation of the surgical and postoperative/postprocedural pain experience is a key factor in the development of the plan. A preemptive, multimodal approach to acute pain management using an enhanced recovery pathway is advantageous across many surgical specialties. The type and duration of the procedure, patient comorbidities, and postoperative physical therapy plan should be taken into consideration.

Patient Engagement and Education

Early and sustained patient engagement is key to the development and implementation of a successful patient-specific multimodal pain management plan. Ideally, the discussion with the patient takes place prior to the day of the procedure and continues throughout the course of their care. If the discussion cannot occur prior to the day of surgery, collaborate with the surgeon or proceduralist to provide information to the patient during the procedure planning appointment. Creating a plan for pain management in collaboration with the patient addresses concerns for reasonable pain management. This can also help minimize the use of opioids while promoting the use of non-opioid analgesics, which may reduce the incidence of readmission and risk of opioid abuse.

Two-way communication is important for the clinician to understand the patient’s prior experiences and expectations of postoperative pain and pain management. A collaborative patient-clinician relationship has been associated with patient agreement with treatment recommendations, greater self-efficacy, and increased clinician empathy. It also predicts patient satisfaction and adherence to treatment recommendations.

Patient and family knowledge and understanding of healthcare varies. Health literacy is defined by the National Academy of Medicine as “the degree to which individuals and groups can obtain, process, understand, evaluate, and act upon information needed to make public health decisions that benefit the community.” Socioeconomic, sensory, language and other factors impact the ability to engage in healthcare decision making. Including caregivers and others in the discussion will help the patient make the best decision for care and safe recovery.
Assessing the patient’s and caregiver’s health literacy supports communication about the anesthetic options. Communicating in a manner that the patient understands helps the patient make an informed decision. Both verbal and written patient education provides the best understanding of the anesthesia care, its timing, and the role of providers at various points throughout the procedure and recovery, including hand off to post-procedure care and discharge. Discuss the risks and potential complications associated with regional anesthesia with the patient and address any questions or concerns as an element of the informed consent process. For additional guidance on the informed consent process, refer to the AANA Policy and Practice Considerations, *Informed Consent for Anesthesia Care*.

**Regional Anesthesia Techniques**

Regional anesthesia techniques may be performed in various locations, including the pre-procedure area, patient room, anesthetizing location, the PACU, or intensive care unit (ICU). Regardless of the location where regional anesthesia is performed, appropriate monitors, oxygen, supplies, equipment, and qualified, licensed support staff must be available during placement to provide hemodynamic support or resuscitation if necessary. Additionally, a formal time-out must be performed, according to facility policy and applicable accreditation standards, to verify the correct patient, site, and procedure. Resuscitation support includes age-specific emergency equipment, supplies, and drugs. Medications must include a supply of intravenous lipid emulsion appropriate for the treatment of local anesthetic systemic toxicity.

Local anesthetics may be used alone or in combination with other medications to provide regional anesthesia. The pharmacokinetics of local anesthetic drugs vary in onset (e.g., slow, moderate, rapid) and duration of action. Therefore, selection of the local anesthetic should be based on the patient, type of block, procedure being performed, and the post-procedure physical therapy plan.

**Aseptic Technique**

Meticulous aseptic technique is critical for the prevention of infection when performing regional anesthesia. As with any sterile procedure, donning a mask, hand hygiene, standard precautions, skin preparation, sterile preparation of drugs, sterile draping, and proper technique specific for the block or guidance technology must be used as outlined in the AANA’s *Infection Prevention and Control Guidelines for Anesthesia Care*.62
**Guided Regional Block Placement**

Guided block placement may be accomplished using one technique or a combination of several techniques appropriate for that regional block. These include anatomic landmark-guided technique (LM) and peripheral nerve stimulation (PNS) used with or without ultrasound-guided regional anesthesia (UGRA). Ultrasound guidance improves the visualization of the anatomy for optimal placement of medication(s) and decreases the risk of local anesthetic systemic toxicity (LAST) and nerve damage when used in combination with PNS. As image-guided technologies are integrated into clinical practice, proficiency must be developed through education, training, and experience. This learning and mentored practice enhances understanding of physical principles and limitations of ultrasound technology, instrumentation, and safety. Demonstrated skill and management competency helps select the best individual and combination of image-guided technology appropriate for the regional block. The CRNA may find the AANA document *Considerations for Adding New Activities to Individual CRNA Scope of Practice* a helpful resource if adding new regional block or image-guided skills to practice.

**Sedated or Anesthetized Patient**

In the awake or sedated patient, paresthesia on injection indicates that the injection must stop and the needle repositioned. Performing regional anesthesia on a heavily sedated patient or after the induction of general anesthesia may increase the risk of postoperative neurologic complications. There is value for the cooperative and awake patient to communicate to the anesthesia professional any paresthesia or pain related discomfort as a result of block placement. The risks and benefits of performing regional anesthesia under sedation or general anesthesia are explored during the informed consent process.

**Continuous Infusion, Patient Controlled Regional Anesthesia**

Continuous nerve blockade using a plexus or perineural catheter provides a valuable tool for the sustained management of post-procedure analgesia. A catheter may be placed in the nerve sheath or near the nerve plexus to provide continuous infusion or intermittent doses of a dilute local anesthetic. Available administration technologies include infusion pumps with disposable medication reservoirs and tubing, and disposable pumps. Other factors to consider when choosing equipment include the cost of the technology, reimbursement, and ease of use following discharge.
Local Anesthetic Systemic Toxicity

Local anesthetic systemic toxicity (LAST) can be a catastrophic central nervous system or cardiac adverse event that occurs when a significant dose of local anesthetic directly enters the systemic circulation or is rapidly absorbed from a highly vascular area.\textsuperscript{70} Numerous factors influence the severity and likelihood of LAST, including patient risk factors, concurrent medications, type and location of block, local anesthetic used, total local anesthetic dose, timeliness of detection, and adequacy of treatment.\textsuperscript{71} The classic description of LAST is that of a progressive excitation then depression of the central nervous system and cardiovascular system. Case reports suggest that seizures, hypertension or hypotension, and electrocardiographic changes are the most common presenting symptoms.\textsuperscript{71,72} Thirty percent of the cases reported the classic prodromal symptoms of auditory and speech changes, metallic taste, agitation, and tremors.\textsuperscript{71,72}

Prevention, over treatment, of LAST is preferred. Vigilance should be heightened in patients younger than 16 and older than 60, those with low muscle mass, and those with underlying cardiac, neurologic, pulmonary, renal, hepatic, or metabolic disease.\textsuperscript{71} Manifestations of LAST typically appear one to five minutes after the injection of local anesthetic. The onset may be as early as 30 seconds or as late as 60 minutes, so it is recommended to observe the patient for at least 30 minutes after injection.\textsuperscript{71} It is important to note that LAST cardiac arrests are often resistant to standard resuscitation measures.\textsuperscript{71-73} Key prevention strategies include:\textsuperscript{71}

- Select shorter acting and less cardiotoxic local anesthetics + epinephrine.
- Minimize sedation during placement.
- Utilize good ultrasound technique (including color flow).
- Aspirate appropriately between 3 – 5 mL injections.
- Limit to one site injection, as possible.
- Minimize the amount of local anesthetic to the minimal effective dose (with knowledge of the maximum dose).
- Before they are used, make sure intralipids are located and accessible.

Management includes oxygenation, airway management when necessary, and treatment of hypotension, dysrhythmias, and seizures. Benzodiazepines are the preferred treatment to control seizure activity but small doses of Propofol may be used in 20 mg increments if benzodiazepines are unavailable.\textsuperscript{71-73} The cardiac arrest related to lidocaine will be of short duration and bupivacaine of longer duration that may respond to lipid emulsion infusion or
cardiopulmonary bypass until the local anesthetic is metabolized. The ASRA Checklist for Treatment of Local Anesthetic Systemic Toxicity (LAST) shown below and 20 percent lipid emulsion should be immediately available.\textsuperscript{73}

**ASRA Checklist for Treatment of Local Anesthetic Systemic Toxicity (LAST)\textsuperscript{*}:**

- Call for help.
- Get LAST rescue kit.
- Consider cardiopulmonary bypass team.
- Consider administering lipid emulsion early.

Is the patient…

- Exhibiting seizures?
  - Ensure adequate airway.
  - Benzodiazepines are preferred.
  - If only Propofol is available, use low dose, e.g., 20 mg increments.
- Exhibiting arrhythmia or hypotension?
  - **BEWARE** – LAST resuscitation is DIFFERENT from standard ACLS.
    - Epinephrine: start with $\leq$1 mcg/kg. (smaller than normal dose preferred)
    - AVOID:
      - Local anesthetics
      - Beta-blockers
      - Calcium-channel blockers
      - Vasopressin
- Patient is stable?
  - Continue lipid emulsion $\geq$15 min once hemodynamically stable.
  - Maximum lipid dose: 12 mL/kg

| Lipid Emulsion 20 percent |  
|----------------------------|---|
| (Precise volume and flow rate are not crucial) |  
| Greater than 70 kg patient | Less than 70 kg patient |
| Bolus $\sim$100 mL Lipid Emulsion 20 percent rapidly over 2-3 minutes | Bolus $\sim$1.5 mL/kg Lipid Emulsion 20 percent rapidly over 2-3 minutes |
- Lipid emulsion infusion ~250 mL over 15-20 minutes
- Lipid emulsion infusion ~0.25 mL/kg/min (consider using a pump if <40 kg)

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<th>If patient remains unstable:</th>
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<td>• Re-bolus same dose</td>
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<tr>
<td>• Double infusion rate - be aware of max limit (12 mL/kg)</td>
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- Once stable, observe:
  - 2 hours after for seizure.
  - 4-6 hours after for cardiovascular instability.
  - As appropriate after cardiac arrest.

- For further details, see the ASRA Checklist for Treatment of Local Anesthetic Systemic Toxicity

*Checklist reproduced with permission from the American Society of Regional Anesthesia and Pain Medicine

Detailed guidance documents, such as The Third American Society of Regional Anesthesia and Pain Medicine Practice Advisory on Local Anesthetic Systemic Toxicity and Checklist for Treatment of Local Anesthetic Systemic Toxicity (LAST) are available on ASRA’s website.

**Intraoperative Management**

As referenced in Standard 7 of the Standards for Nurse Anesthesia Practice, the CRNA will “implement and, if needed, modify the anesthesia plan of care by continuously assessing the patient’s response to the anesthetic and surgical or procedural intervention.” Additionally, Standard 9 states that the CRNA will “monitor, evaluate, and document the patient’s physiologic condition as appropriate for the procedure and anesthetic technique.” The CRNA “provides anesthesia care until the responsibility has been accepted by another anesthesia professional.”

**Post-procedural Management**

When transferring care of the patient following the surgical, diagnostic or therapeutic procedure, the CRNA will “evaluate the patient’s status and determine when it is appropriate to transfer the
responsibility of care to another qualified healthcare provider.\textsuperscript{50} The CRNA provides report to handoff care to another qualified healthcare provider.\textsuperscript{50,56} The handoff of care includes the patient’s name, allergies, surgery or procedure performed, anesthesia and analgesia, pertinent health history, volume and hemodynamic status, any complications or concerns, and plan for post-procedure care.\textsuperscript{50,56}

In the recovery area prior to discharge, the patient is assessed for side effects and complications related to the regional anesthetic. Specific to neuraxial techniques, early symptoms may include, but are not limited to, hypotension, nausea and vomiting, back difficulty, difficulty voiding, weakness, and post dural puncture headache in the case of an inadvertent dural puncture.\textsuperscript{7-10} Later symptoms may include sensory and motor loss after the block has ended due to nerve injury or epidural hematoma.\textsuperscript{2} Suspicion of an epidural hematoma requires immediate assessment and treatment, if present, to prevent or minimize neurologic damage.\textsuperscript{74} Abscess and meningitis are later significant infectious outcomes.\textsuperscript{10} Prior to discharge, patients receive instructions on signs and symptoms to be aware of and who to contact should any concerns arise.

Conclusion
Vigilance, professionalism, and promotion of optimal outcomes are hallmarks of patient-driven anesthesia care provided by CRNAs. Advancements in regional anesthesia techniques, integration of ultrasound-guidance, and the demand for affordable healthcare have spurred innovation in the delivery of anesthesia services for best patient outcomes. CRNAs collaborate with the patient and the care team to provide anesthesia services that, when appropriate, include regional anesthesia as part of a multimodal pain management plan to minimize or eliminate the need for opioids. This plan enables the patient’s rapid return to health without dependence on opioids.

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doi:10.1016/j.bjae.2021.11.008


doi:10.1016/j.anclin.2019.01.004


Adopted as *Regional Anesthesia for Surgical Procedures and Acute Pain Management, Practice Considerations* by AANA Board of Directors July 2014

Revised as *Regional Anesthesia and Analgesia Techniques - An Element of Multimodal Pain Management, Practice Considerations* by AANA Board of Directors April 2018

Revised as *Regional Anesthesia Techniques - An Element of Multimodal Pain Management, Practice Considerations* by AANA Board of Directors TBD

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