Regional Anesthesia and Analgesia Techniques - An Element of Multimodal Pain Management

Practice Considerations

Introduction

Regional block techniques are gaining increasing popularity for surgical anesthesia and analgesia to allow the patient to return to preprocedure status more quickly and minimize or eliminate the need for opioid analgesics. Regional techniques desensitize a specific part of the body to a painful stimulus using a local anesthetic that may be combined with other medications to increase the duration of the block or provide analgesia.

Patients who undergo surgical procedures experience improved recovery when the need for opioids is minimized or eliminated through opioid-sparing, multimodal pain management that may include regional techniques for analgesia. In spite of enhanced recovery techniques, research suggests that postoperative pain continues to be undertreated.[1-4] Acute pain management services provided by anesthesia professionals help patients with faster recovery and contribute to higher patient satisfaction.

Pain management services are optimized when they are patient and procedure-specific. Key elements of patient-centered surgical and acute pain management services include patient engagement through shared planning and education to address the patient's specific needs. This document is a companion to the American Association of Nurse Anesthetists (AANA) *Enhanced Recovery after Surgery*.[5]

Regional Anesthesia and Analgesia Background

Regional anesthesia techniques may include, but are not limited to, spinal, epidural, peripheral nerve block, upper and lower extremity block, and transversus abdominis plane (TAP) blocks. In addition to placement of local anesthetics for regional block, local anesthetics may be used for topical or surface anesthesia, local infiltration, peripheral nerve block, intravenous regional anesthesia, epidural anesthesia, and spinal (subarachnoid) anesthesia.[6] Regional anesthesia techniques may be used alone, or in combination with other anesthetic techniques, to provide anesthesia and analgesia for a variety of surgical, obstetrical, diagnostic, and therapeutic procedures as well as for chronic pain management. They may be administered by infiltration, single injection, or using a catheter for intermittent or continuous medication administration. Regional anesthesia in combination with other anesthesia and analgesia techniques can minimize side effects of an individual anesthetic technique, maximize benefits, and offer the patient options in the selection of anesthesia and analgesia.[7]

Regional Anesthesia Benefits

Incorporating regional techniques for preemptive analgesia is associated with a reduction in postoperative pain,[8-13] improved visual analog scale pain scores,[14-17] decreased incidence of postoperative nausea and vomiting,[9,15,18-20] reduction or elimination of opioids,[9,10,13,15-19,21,22] shorter postanesthesia care unit (PACU) stay,[16,19] shorter time to discharge from the facility,[12,15,16,20] earlier rehabilitation,[15,20] shorter time to resume normal activities,[16,23] and increased patient satisfaction.[12,18,24] The use of regional anesthesia has also been associated

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with a reduced incidence of postsurgical pain three to twelve months after surgery, decreasing risk of prolonged opioid use.[23,25,26] Regional anesthesia may positively impact long-term healing and immune function.[27,28]

Settings

Regional anesthesia use is not limited to the hospital setting. Due to the clinical value of regional anesthesia, it continues to be used safely and effectively in ambulatory[29-31] and office-based[32-35] settings. Klein et al. conducted a literature review analyzing peripheral nerve block use in the ambulatory setting and found support for peripheral nerve block use. The literature cited improved postoperative analgesia, opioid sparing, and fewer opioid-related side effects when compared to general anesthesia and parenteral analgesia.[31] In a retrospective chart review, Hausman et al. demonstrated that providing spinal and peripheral nerve blocks in an orthopedic surgery office does not increase the amount of office-based operating room time and is not associated with increased morbidity.[33] Ambulatory and office-based facilities have appropriate policies, equipment and staff present in the facility to maintain patient safety, indicated monitoring, and address emergencies. For additional guidance, refer to the AANA *Standards for Office Based Anesthesia Practice*.[36]

CRNA Scope of Practice

Regional anesthesia education and skill development are core elements of nurse anesthesia educational programs. The Council on Accreditation of Nurse Anesthesia Educational Programs (COA) specifies the didactic and clinical experience requirements necessary to develop regional anesthesia core competencies.[37] These core competencies are the foundation of the CRNA regional anesthesia scope of practice.[38] The nurse anesthetist engages in life-long learning to provide evidence-based care specific to practice and patient population. 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.[39]

Considerations

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

Pediatric

Many factors make the assessment of pain unique and challenging in the pediatric population. Age, cognitive, behavioral, and psychosocial factors influence the pediatric patient's pain experience.[40] It is important to engage the parent(s) or caregiver(s) in a discussion about the value of effective pain management to create a sense of safety for the child. There are many valid age, developmental, and culturally appropriate pain assessment tools that are available to assist with the patient's analgesic or alternative therapy needs.[41] Initially, a combination of observational and self-report scales may help to identify the best tool and engage the child in self-assessment for optimal management of discomfort. An observational pain scale has been found to be most effective for children who are younger than four years of age and those who are not able to self-report. After four years of age, self-reported assessment of discomfort is effective.

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Regional anesthesia and analgesia 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. Many pediatric blocks are placed under sedation or general anesthesia, which is different from placement of a block in an awake and responsive adult patient. Ultrasound-guidance has increased the efficacy and safety of epidural injections, nerve blocks, and other regional techniques for all patients and specifically for the pediatric patient under sedation or general anesthesia.[11,21,42-44]

Senior or Geriatric

Recovery after sedation, anesthesia, and opioid analgesia may be delayed when the senior or geriatric patient experiences a change in routine, environment, health status, or has limited social support available.[45] In addition to physical and sensory changes, the senior patient may experience cognitive changes in the postprocedure 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 block technique for anesthesia and analgesia, used in combination with multimodal analgesics, offers an effective option to reduce the risk of postprocedural complications for the senior patient.[46-48]

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.[49,50] In addition, the patient is assessed for systemic infection at the planned insertion or injection site of the block, 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 catheter dislodgement.[51-53] These factors may potentially lead to complications and increase block failure.[53] 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. Regional anesthesia has been associated with lower complication rates than general anesthesia in patients with obstructive sleep apnea when opioids are minimized or eliminated from the plan of care.[54]

Coagulation Status

History of recent venous thromboembolism and current or recent antithrombotic or thrombolytic therapy are contraindicated for the regional block procedure and require additional considerations.[55,56] Consultation with the patient's primary or specialty care practitioner may be considered prior to proceeding with the block.[55]

Thromboprophylaxis management regimes vary. Patient-specific therapy and coagulation status are considered and optimized prior to neuraxial needle placement and if a catheter was placed, assessed prior to catheter removal.[56] The American Society of Regional Anesthesia

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and Pain Medicine's (ASRA's) Practice Advisory, *Regional Anesthesia in the Patient Receiving Antithrombotic or Thrombolytic Therapy*, provides specific guidance regarding regional anesthesia administration for patients on thromboprophylactic therapy.[56]

Patient Assessment and Evaluation

Standard I of the *Standards for Nurse Anesthesia Practice* states that CRNAs "perform and document a thorough preanesthesia assessment and evaluation."[57] 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.[58] During the preanesthesia assessment, health history and current status are reviewed and evaluated to develop the patient-specific perioperative plan of care.

Patient-Specific Perioperative Treatment Plan

Standard III of the *Standards for Nurse Anesthesia Practice* states that CRNAs "formulate a patient-specific plan for anesthesia care."[57] The patient's expectation of the surgical and postoperative pain experience is a key factor in the development of the plan. A preemptive, multi-modal approach to acute pain management using an enhanced recovery pathway has been shown to be advantageous across many surgical specialties.[14-17,20,22,59,60] The type and duration of the procedure, patient comorbidities, and postoperative physical therapy plan should be taken into consideration. Studies have demonstrated that preemptive analgesia may improve the patient's postoperative acute pain experience, minimize the transition to a chronic pain state, and have a positive, long-term effect.[14,59,61,62]

Patient Engagement

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 patient care.[63] 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 care in collaboration with the patient addresses concerns for reasonable pain management. This plan also helps minimize the use of opioids in favor of non-opioid analgesics to reduce readmission and risk of opioid abuse.[64,65]

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.[66]

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 have the capacity to obtain, process, and understand basic health information as services needed to make appropriate health decisions."[67] 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.

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Assessing the patient's and caregiver's health literacy supports communication about the anesthetic and analgesia 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 clinicians at points during the procedure and recovery, including hand off to postprocedure care and discharge.[65,68] Discuss the regional anesthesia and analgesia risks and potential complications with the patient and address any questions or concerns as an element of the informed consent process.[35,69] For additional guidance on the informed consent process, refer to AANA *Informed Consent for Anesthesia Care*.[69]

Regional Block Placement

Block placement may occur in various facility locations, including the pre-procedure area, patient room, anesthetizing location, a PACU, or intensive care unit (ICU). Regardless of the location of the block placement, appropriate monitors, oxygen, supplies, equipment, and qualified, licensed support staff must be available during block placement to provide hemodynamic support or resuscitation, if necessary. Resuscitation support includes age-specific emergency equipment and supplies and drugs. Drugs must include a supply of intravenous lipid emulsion appropriate for local anesthetic toxicity resuscitation.[7,70,71]

Local anesthetics may be used alone or in combination with other drugs to provide regional anesthesia or analgesia.[7,35,55] The pharmacokinetics of local anesthetic drugs vary in onset (e.g., slow, moderate, rapid) and duration of action.[6,7,35,55] Therefore, select the local anesthetic based on the patient, type of block, procedure, and the postprocedure physical therapy plan.

Aseptic Technique

Meticulous aseptic technique is critical to prevent infection in the placement and management of regional anesthesia. As with any sterile procedure, 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 *Infection Prevention and Control Guidelines for Anesthesia Care*.[72]

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 in combination with or without ultrasound-guided regional anesthesia (UGRA).[73] Ultrasound guidance improves the visualization of the anatomy for optimal placement of medication(s) and decrease the risk of local anesthetic systematic toxicity (LAST) and nerve damage when used in combination with PNS.[13,70-7873]

As image-guided technologies are integrated into clinical practice, proficiency is developed through education, training and experience.[74] 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.[75,76] The CRNA may find the AANA document *Considerations for Adding New Activities to Individual CRNA Scope of Practice*[77] a helpful resource if adding new regional block or image-guided skills to practice.

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Sedated or Anesthetized Patient
When the patient has received anxiolysis or is awake for the peripheral nerve block, neuropathic pain on injection indicates that the injection must stop and the needle repositioned.[78] Regional block placement after the patient is heavily sedated or after the induction of general anesthesia may increase the risk of postoperative neurologic complications.[79] UGRA and PNS used in combination decrease the risk of nerve injury. There is value for the cooperative and awake patient to communicate any paresthesia or pain related discomfort as a result of block placement to the anesthesia professional.[49,79] The risks and benefits of block placement under sedation or general anesthesia are explored during the informed consent process.

Continuous Infusion, Patient Controlled Regional Anesthesia
Continuous nerve blocks using a plexus or perineural catheter provide a valuable tool for the anesthesia management for the procedure of anticipated long duration and for sustained management of postprocedure analgesia.[80] 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.[81,82] Available administration technologies include infusion pump with disposable medication reservoir and tubing and disposable pumps. Purchase decision points include cost of technology, reimbursement, and use in postdischarge.

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.[83]

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.[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 seizure is the most common presenting symptom.[71] Twenty percent of the cases reported the classic prodromal symptoms of auditory changes, metallic taste, and agitation.[70,71] These symptoms are followed by unexpected cardiovascular manifestations of excitation (e.g., tachycardia, ventricular arrhythmia, and hypertension) then depression (e.g., bradycardia, conduction block, asystole, and cardiac depression).[70] Vigilance should be heightened in patients with underlying cardiac, neurologic, pulmonary, renal, hepatic, or metabolic disease.[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.[71] It is important to note that LAST cardiac arrests are often resistant to standard resuscitation measures.[70]

Management includes oxygenation, airway management when necessary, and treatment of hypotension, dysrhythmias, and seizures. Propofol and benzodiazepines are used to control seizure activity. The pharmacologic treatment of LAST differs from other cardiac arrest scenarios.[84] 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 *Checklist for Treatment of Local Anesthetic Systemic Toxicity* and 20 percent lipid emulsion should be immediately available.[71,84]

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ASRA Guidance for the Use of Lipid Infusion for Resuscitation of Local Anesthetic Systemic Toxicity*:[84]

The Pharmacologic Treatment of LAST is Different from Other Cardiac Arrest Scenarios

- ❖ **Reduce** individual **epinephrine** boluses to ≤ 1 mcg/kg
- ❖ **Avoid** vasopressin, calcium channel blockers, beta blockers, or other local anesthetics

- ❑ Stop injecting local anesthetic
- ❑ Get Help
  - ❑ Consider lipid emulsion therapy at the first sign of a serious LAST event
  - ❑ Call for the LAST Rescue Kit
  - ❑ Alert the nearest cardiopulmonary bypass team – resuscitation may be prolonged
- ❑ Airway management
  - ❑ Ventilate with 100 percent oxygen / avoid hyperventilation / advanced airway device if necessary
- ❑ Control seizures
  - ❑ Benzodiazepines are preferred
  - ❑ **Avoid** large doses of **propofol**, especially in hemodynamically unstable patients
- ❑ Treat hypotension and bradycardia – **If pulseless, start CPR**

<table>
<tr><th colspan="2">Lipid Emulsion 20 percent
(Precise volume and flow rate are not crucial)</th></tr>
<tr><td>Greater than 70 kg patient</td><td>Less than 70 kg patient</td></tr>
<tr><td>Bolus 100 mL Lipid Emulsion 20 percent
rapidly over 2-3 minutes
• Lipid emulsion infusion 200-250 mL over 15-20 minutes</td><td>Bolus 1.5 mL/kg Lipid Emulsion 20 percent
rapidly over 2-3 minutes
• Lipid emulsion infusion ~0.25 mL/kg/min (ideal body weight)</td></tr>
<tr><td colspan="2">If patient remains unstable:
• Re-bolus once or twice at the same dose and double infusion rate; be aware of doing limit (12 mL/kg)
• Total volume of lipid emulsion can approach 1 L in a prolonged resuscitation (e.g., > 30 minutes)</td></tr>
</table>

- ❑ Continue monitoring
  - ❑ At least 4-6 hours after a cardiovascular event
  - ❑ Or, at least 2 hours after a limited CNS event
- ❑ Do not exceed 12 mL/kg lipid emulsion (particularly important in the small adult or child)
  - ❑ Much smaller doses are typically needed for LAST treatment
- ❑ For further details, see the *Checklist for Treatment of Local Anesthetic Systemic Toxicity*

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

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Detailed guidance documents, such as the *ASRA Practice Advisory on Local Anesthetic Systemic Toxicity*[71] and *Checklist for Treatment of Local Anesthetic Systemic Toxicity*,[84] are available on ASRA's website.

Intraoperative Management

As referenced in Standard IV of the *Standards for Nurse Anesthesia Practice,* the CRNA will "implement and adjust the anesthesia care plan based on the patient's physiologic status. Continuously assess the patient's response to the anesthetic, surgical intervention, or procedure. Intervene as required to maintain the patient in optimal physiologic condition."[57] Additionally, Standard V states that the CRNA will "monitor, evaluate, and document the patient's physiologic condition as appropriate for the type of anesthesia and specific patient needs."[57] The CRNA attends to the patient "continuously until the responsibility of care has been accepted by another anesthesia professional or a qualified, licensed provider."[57]

Postprocedure Management

When transferring care of the patient following the surgical, diagnostic or therapeutic procedure, the CRNA "evaluates the patient's status to determine that the patient is stable for appropriate transfer of the responsibility for care."[57] The CRNA provides report to handoff care to another qualified healthcare provider. The handoff of care includes the patient's name, allergies, pertinent health history, volume and hemodynamic status, and plan for postprocedure care.[57]

In the recovery area and prior to and after 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 a spinal or inadvertent dural puncture. Later symptoms may include sensory and motor loss after the block has ended due to nerve injury or epidural hematoma. Suspicion of an epidural hematoma requires immediate assessment and treatment if present to prevent or minimize neurologic damage. Abscess and meningitis are later significant infectious outcomes.[85,86] Prior to discharge, patients receive instructions on signs and symptoms to be aware of and who to contact with any concerns that may arise.

Conclusion

Vigilance, professionalism, and promotion of optimal outcomes are hallmarks of patient-driven anesthesia care provided by CRNAs. Advancements in regional block techniques, integration of ultrasound guidance for block placement, and the demand for affordable healthcare have spurred innovation in the delivery of anesthesia services for best patient outcomes.[87] CRNAs collaborate with the patient and the care team to provide anesthesia services that, when appropriate, include regional anesthesia and analgesia 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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