

2. PERIPHERAL NERVE BLOCK EQUIPMENT

INTRODUCTION

The safe and successful application of regional anesthesia in patients requires specialized training and equipment. In 2005, guidelines for regional anesthesia fellowship training were published in the journal *Regional Anesthesia and Pain Medicine*. The guidelines were a collaborative effort of a group of North American regional anesthesia fellowship program directors who met to establish a standardized curriculum. An important part of this document is the categorization of regional anesthetic procedures into basic, intermediate, and advanced techniques. The Walter Reed Army Medical Center (WRAMC) regional anesthesia fellowship program has adopted this categorization as well as the published guidelines (Table 2-1).

This manual will focus on intermediate and advanced regional anesthesia techniques and acute pain therapies, which may not be included in routine anesthesia training. Some basic techniques are covered as well (with the exception of neuraxial anesthesia). The primary purpose of this manual is to serve as a guide for WRAMC resident and fellow anesthesiologists during their regional anesthesia and acute pain rotations. The facility, equipment, and staffing solutions used at WRAMC may not be entirely workable at other institutions; however, the editors are confident that other clinicians can benefit from this systematic approach to regional anesthesia and acute pain medicine.

Contemporary regional anesthesia increasingly relies on sophisticated equipment, as providers strive for accurate and safe methods of needle placement and anesthetic delivery. This chapter will review the equipment used at WRAMC as well as on the modern battlefield in the successful performance of regional anesthesia. *Note: The equipment displayed in this chapter is for illustration purposes only and should not be considered an endorsement of any product.*

TABLE 2-1

CLASSIFICATION OF REGIONAL ANESTHESIA TECHNIQUES AT WALTER REED ARMY MEDICAL CENTER

Basic Techniques	Intermediate Techniques	Advanced Techniques
<i>Anesthesia providers who have completed an accredited anesthesia program should be familiar with these techniques.</i> • Superficial cervical plexus block • Axillary brachial plexus block • Intravenous regional anesthesia (Bier block) • Wrist block • Digital nerve block • Intercostobrachial nerve block • Saphenous nerve block • Ankle block • Spinal anesthesia • Lumbar epidural anesthesia • Combined spinal-epidural anesthesia • Femoral nerve block	<i>Should be familiar to anesthesia providers who have completed a supervised program in regional anesthesia and have demonstrated proficiency in these techniques (usually 20–25 blocks of each type).</i> • Deep cervical plexus block • Interscalene block • Supraclavicular block • Infraclavicular block • Sciatic nerve block: posterior approach • Genitofemoral nerve block • Popliteal block: all approaches • Suprascapular nerve block • Intercostal nerve block • Thoracic epidural anesthesia	<i>Should be familiar to anesthesiologists with advanced or fellowship training in regional anesthesia appropriate for a subspecialist consultant in regional anesthesia.</i> • Continuous peripheral nerve blocks: placement and management • Ultrasound guided regional anesthesia • Thoracolumbar paravertebral blocks • Lumbar plexus block • Sciatic nerve block: anterior approach • Obturator nerve block • Cervical epidural anesthesia • Cervical paravertebral block • Maxillary nerve block • Mandibular nerve block • Retrobulbar and peribulbar nerve blocks

REGIONAL ANESTHESIA AREA

Regardless of the practice environment (military care level III through IV), a designated area for the application of regional anesthesia techniques outside of the operating room will enhance block success. This alternative location for nerve block placement will prevent unnecessary operating room delays, allow additional time for long-acting local anesthetics to “set up,” and allow the provider to assess the quality of the nerve block prior to surgery. Other advantages of a regional anesthesia area include

reduced anesthesia turnover times and improved patient-anesthesiologist relationships. Finally, the regional anesthesia area greatly enhances resident education by providing an instructional environment free from the pressures and distractions of a busy operating room.

The regional block area should have standard monitoring, oxygen, suction, airway, and emergency hemodynamic equipment. Certain military practice environments will necessitate adjustments or alternatives to this equipment list. Advanced cardiac life support capability and medications

should be readily available as well as Intralipid (KabiVitrum Inc, Alameda, Calif). Recent data have shown Intralipid to be an effective therapy for cardiac arrest related to local anesthetic toxicity (see Table 3-2 for Intralipid dosing).

PATIENT CONSENT FOR REGIONAL ANESTHESIA

As with any medical procedure, proper consent for the nerve block and documentation of the procedure (detailing any difficulties) is essential. Counseling should include information on risks of regional anesthesia, including intravascular injection, local anesthetic toxicity, and potential for nerve injury. Patients receiving regional anesthesia to extremities should be reminded to avoid using the blocked extremity for at least 24 hours. In addition, patients should be warned that protective reflexes and proprioception for the blocked extremity may be diminished or absent for 24 hours.

Particular attention must be paid to site verification prior to the nerve block procedure. Sidedness should be confirmed orally with the patient as well as with the operative consent. The provider should initial the extremity to be blocked. If another anesthesia provider manages the patient in the operating room, the provider who places the regional block must ensure that the accepting anesthesia provider is thoroughly briefed on the details of the block procedure.

EQUIPMENT

Needles. A variety of quality regional anesthesia stimulating needles are available on the market today. Qualities of a good regional anesthesia needle include the following:

- Stimulating needles should be insulated along the shaft, with only the tip exposed for stimulation.
- A comfortable finger grip should be attached to the proximal end of the needle.
- The wire attaching the needle to the stimulator should be soldered to the needle's shaft and have an appropriate connector for the nerve stimulator.
- Long, clear extension tubing must also be integral to the needle shaft to facilitate injection of local anesthetic and allow for early detection of blood through frequent, gentle aspirations.
- Stimulating needles are typically beveled at 45° rather than at 17°, as are more traditional needles, to enhance the tactile sensation of the needle passing through tissue planes and to reduce the possibility of neural trauma.
- Finally, markings on the needle shaft in centimeters are extremely helpful in determining needle depth from the skin.

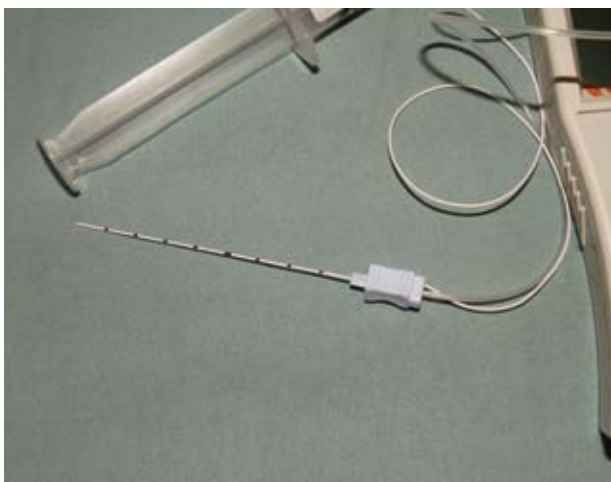


Figure 2-1. Representative single injection, 90-mm, insulated peripheral nerve block needle (StimuQuik, Arrow International Inc, Reading, Pa; used with permission)

Centimeter markings on the needle shaft are particularly important now that ultrasound technology can provide accurate measurements of skin to nerve distances (Figure 2-1). A typical back table set-up for a peripheral nerve anesthetic is illustrated in Figure 2-2. Figure 2-3 provides the preferred method for all local anesthetic injections.



Figure 2-2. Set-up for peripheral nerve block
A: ruler and marking pen for measuring and marking landmarks and injection points
B: alcohol swabs and 25-gauge syringe of 1% lidocaine to anesthetize the skin for needle puncture
C: chlorhexidine gluconate (Hibiclens, Regent Medical Ltd, Norcross, Ga) antimicrobial skin cleaner
D: syringes for sedation (at WRAMC, having 5 mg midazolam and 250 mg fentanyl available for sedation is standard)
E: local anesthetic
F: peripheral nerve stimulator
G: stimulating needle
H: sterile gloves

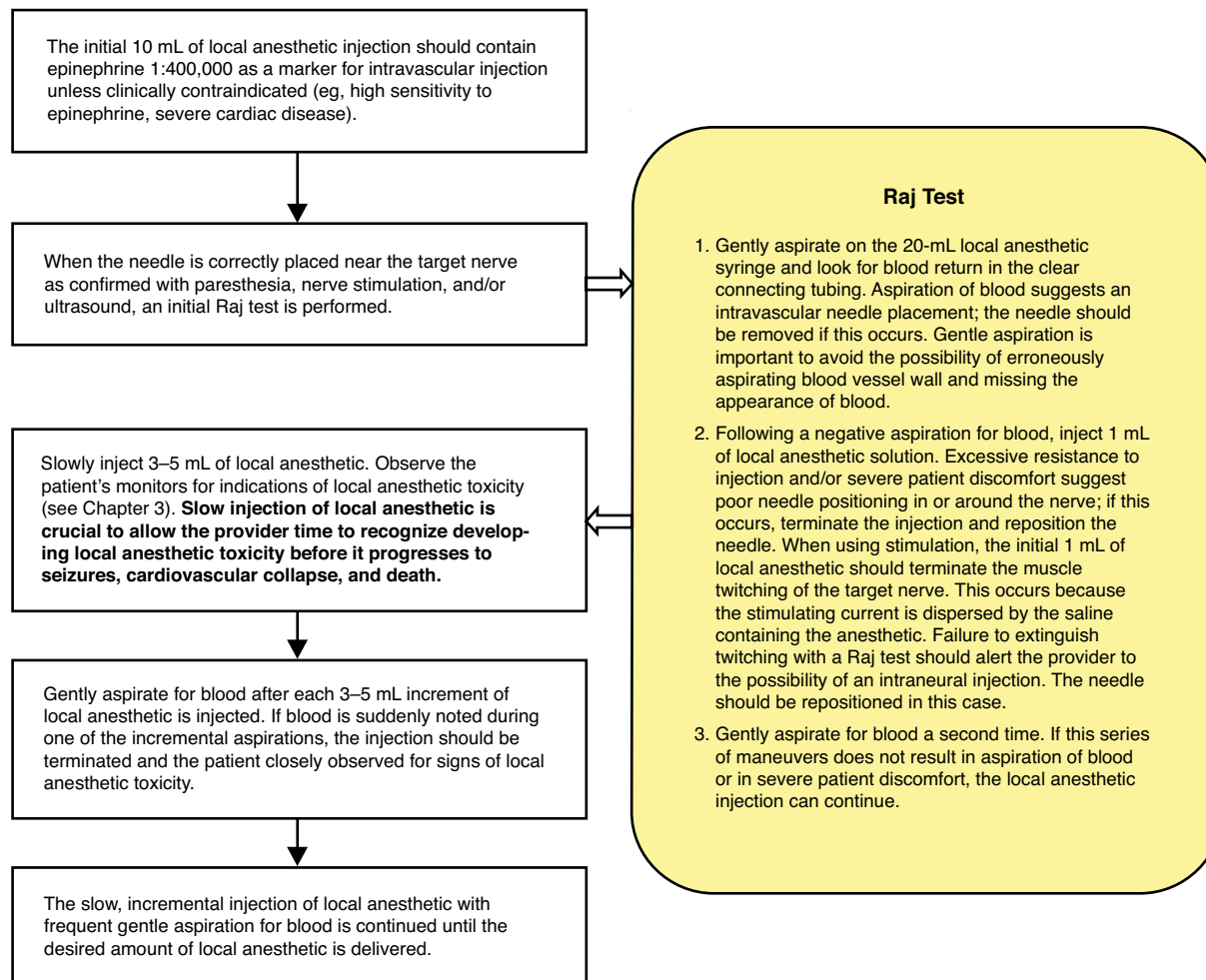


Figure 2-3. Procedure for injection of all local anesthetics

Peripheral Nerve Block Stimulators. Peripheral nerve stimulation has revolutionized the practice of regional anesthesia by providing objective evidence of needle proximity to targeted nerves. In the majority of peripheral nerve blocks, stimulation of nerves at a current of 0.5 mA or less suggests accurate needle placement for injection of local anesthetic. Chapter 4, Nerve Stimulation and Ultrasound Theory, discusses nerve stimulation in detail. A variety of peripheral nerve stimulators are available on the market. A good peripheral nerve stimulator has the following characteristics:

- a light, compact, battery-operated design with adjustable current from 0 to 5 mA in 0.01 mA increments at 2 Hz impulse frequency;
- a bright and easily read digital display;
- both a visual and audible signal of an open or closed circuit between the stimulator, needle, and patient; and
- an impulse duration adjustable between 0.1 millisecond (ms) and 1 ms.

Continuous Peripheral Nerve Block Catheters. Chapter 24, Continuous Peripheral Nerve Block, provides details on WRAMC procedures for placing and securing continuous peripheral nerve block (CPNB) catheters. The majority of catheters placed at WRAMC and in the field are nonstimulating catheters (Figure 24-1) because of how long the catheters remain in situ—1 to 2 weeks on average—and currently available stimulating catheter systems recommend removal after 72 hours (however, new catheter technology may soon change this limitation). In the management of combat wounded, hundreds of nonstimulating CPNB catheters have been placed to manage pain for weeks, some as long as a month, without complication related to the catheter. Desirable characteristics of a long-term CPNB catheter are listed in Table 2-2. The Contiplex Tuohy (B

Braun Melsungen AG, Melsungen, Germany) CPNB nonstimulating catheter system used at WRAMC has had years of successful long-term use in combat casualties and remains the recommended CPNB system for the field.

Ultrasound. Some regional anesthesia providers consider recent developments in ultrasound technology to be the next “revolution” (after peripheral nerve stimulation) in regional anesthesia. Improvements in ultrasound technology allow for high image resolution with smaller, portable, and less expensive ultrasound machines (Figure 2-4). Elements of a superior ultrasound machine for regional anesthesia are high image quality, compact

Figure 2-4. Contemporary laptop ultrasound machine (Logiq Book XP, GE Healthcare, Buckinghamshire, United Kingdom; used with permission)

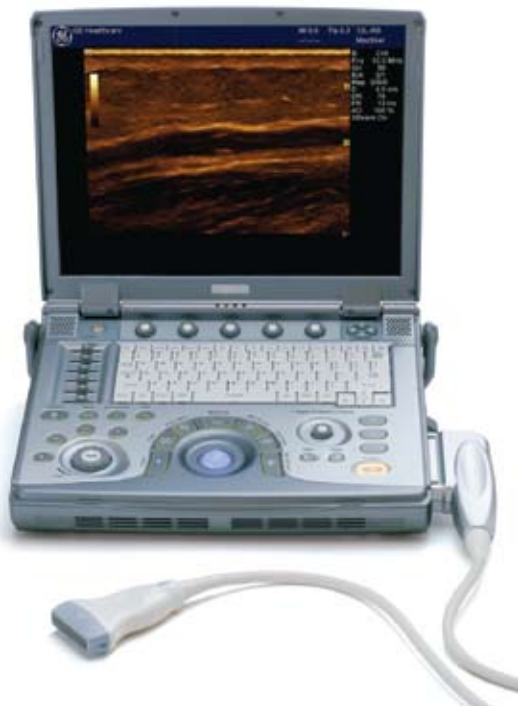


TABLE 2-2

DESIRABLE CHARACTERISTICS OF A LONG-TERM CONTINUOUS PERIPHERAL NERVE BLOCK CATHETER

- Easily placed through a standard 18-gauge Tuohy needle
- Composed of inert, noninflammatory material
- Centimeter markings to estimate depth/catheter migration
- Colored tip to confirm complete removal from patient
- Flexible, multiorifice tip
- Hyperechoic on ultrasound
- Radiopaque
- Secure injection port
- Capable of stimulation
- Nonadherent with weeks of internal use
- High resistance to breaking or kinking
- Low resistance to infusion
- Bacteriostatic
- System to secure the catheter to the patient's skin

and rugged design, simple and intuitive controls, easy image storage and retrieval, and ease of portability. Ultrasound for peripheral nerve blocks is discussed in Chapter 4.

Infusion Pumps. Recent improvements in acute pain management on the battlefield would have been impossible without improvements in microprocessor-driven infusion technology. The use

TABLE 2-3

DESIRABLE CHARACTERISTICS OF A MILITARY PAIN INFUSION PUMP

- Easily identifiable by shape and color
- Used only for pain service infusions
- Lightweight and compact
- Reprogrammable for basal rate, bolus amount, lockout interval, and infusion volume
- Battery operated with long battery life
- Program lock-out to prevent program tampering
- Simple and intuitive operation
- Medication free-flow protection
- Latex free
- Visual and audible alarms
- Stable infusion rate at extremes of temperature and pressure
- Inexpensive
- Durable for long service life without needing maintenance
- Certified for use in US military aircraft

of CPNB and other pain management techniques during casualty evacuation depends on this technology. Infusion pumps for the austere military environment should have the attributes listed in Table 2-3. The pain infusion pump currently used during casualty evacuation for patient-controlled analgesia (PCA), epidural catheters, and CPNB is the AmbIT PCA pump (Sorenson Medical Inc, West Jordan, Utah [Figure 2-5]).



PCA Infusion Pump: Quick Setup & Programming Guide



Step A: Prepare Cassette

1. Attach Cassette to solution container.
2. Prime Cassette by squeezing solution container until all air is removed from bag and tubing.
3. Snap Cassette bottom disc into place to lock fluid path.
4. Bend away the wings of the protective cover. Insert the octagonal opening of the protective cover onto the shaft of the Cassette. Rotate shaft four (4) times counter-clockwise. Remove protective cover.



Step B: Attach Cassette to Pump



Step C: Program Pump

1. Power on the Pump (see Clinician Manual).
2. To enter the programming mode, press and hold both the Run/Pause and Bolus buttons at the same time until one (1) beep is heard. "PRO" will appear in the display.
3. Set the program number (1-5) by pressing and releasing the

Run/Pause button to increase the program number, or the Bolus button to decrease the program number.

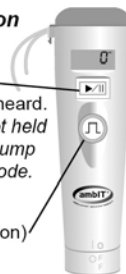
4. To accept the program number, press and hold either the Run/Pause or Bolus button until one (1) beep is heard.
5. If Program 1-4 is chosen, set the Volume to be Infused by pressing and releasing the Run/Pause button to increase the volume, or the Bolus button to decrease the volume.
6. Once the desired Volume to be Infused is blinking on screen, press and hold either the Run/Pause or Bolus button until one (1) beep is heard.
7. If Program 5 is chosen, move on to step C: number 8.
8. The "ml/hr" indicator will begin to blink. Set the infusion rate by pressing and releasing the Run/Pause button to increase the rate, or the Bolus button to decrease the rate.
9. To accept the setting, press and hold either button. The pump will beep and advance to the tenths number.
10. Repeat steps 8 and 9 to set the Bolus Volume, Bolus Lockout Time, and the Volume to be Infused. When all steps are complete, the Pause indicator will blink in the display.

Program #5 Example Settings

Infusion Rate	3.0
Bolus Volume	2.2
Bolus Lockout Time	00:20
Volume to be Infused	250
Pause Indicator	[Pause Icon]

Step D: Start Infusion

1. Press and hold the Run/Pause button until one (1) beep is heard.
NOTE: If button is not held until beep is heard, pump will not go into run mode.
2. The green Run light (inside the Bolus button) will begin to blink.



Step E: Pausing Infusion

1. Press and hold the Run/Pause button until two (2) beeps are heard. The Pause indicator will be displayed.
NOTE: If button is not held until beeps are heard, pump will not go into pause mode.

Step F: Review Program Settings

1. Place the Pump in pause mode.
2. Press and release the Bolus button. Rx will appear in the display. Pump will then scroll through the program settings: (Program #, Basal Rate, Bolus Volume, Bolus Lockout Time, and Volume to be Infused).

Step G: Viewing & Clearing History

1. Viewing History:
 - a. Place the Pump in Pause. [Pause Icon]
 - b. Press and hold the Bolus button until one (1) beep is heard and "HX" is in the display. [HX Icon]

Release button and the Pump will scroll through the four history parameters:

 1. total ml infused
 2. # of bolus delivered
 3. # of bolus requests
 4. elapsed time
2. Clearing History: (Pump must be unlocked. See Clinician Manual.)
 - c. Perform steps a and b.
 - d. Release the button and again press and hold the Bolus button until one (1) beep is heard and "HX 0" is displayed. [HX 0 Icon]
 - e. Press and hold the Run/Pause button again until one (1) beep is heard to resume infusion. [Run/Pause Icon]

For 24 hour Clinical / Technical Assistance:
Call: (801) 352-1888
Toll Free (U.S.): (877) 352-1888

For complete pump operation instructions, see Clinician Manual.
1375 West 8040 South, West Jordan, UT 84088, USA
Fax: (801) 352-1818 www.sorensonmedical.com



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Figure 2-5. Casualty evacuation acute pain management pump (AmbIT PCA pump [Sorenson Medical Inc, West Jordan, Utah; used with permission]) in current use, with operating instruction quick reference card