



# Patient Safety Considerations for Bedside Interventions

Nicholas Alvey and Narayana Varhabhatla

## Essential Concepts

- The primary concern of bedside procedures is to avoid doing any harm to the patient while providing relief from pain.
- Understanding the anatomy of the procedure being done is paramount. Understanding the adjacent structures can help to diagnose complications if they arise.
- Knowing the potential complications unique to each procedure can help the injecting physician respond quickly should a complication arise.
- In a busy pain practice, it is easy to skip simple steps such as universal protocol, time out, and meticulous antisepsis. But these are critical in keeping the physician and the patient safe.

## 1 Overview

Keeping patients safe and avoiding complications are critical goals when performing bedside interventional procedures [1]. Knowing the patient, pertinent anatomy, indications for the procedure, and doing procedures with the most up-to-date techniques are critical for patient safety. This chapter reviews aspects of patient safety that are most pertinent to bedside interventions.

---

N. Alvey · N. Varhabhatla (✉)

Department of Anesthesiology, University of Colorado Medical Center, Aurora, CO, USA

e-mail: [Nicholas.alvey@usap.com](mailto:Nicholas.alvey@usap.com); [Narayana.varhabhatla@cuanschutz.edu](mailto:Narayana.varhabhatla@cuanschutz.edu)

## 2 Procedure Preparation

Preparation is key to safety, and each clinic's process should be standardized as much as possible to minimize the possibility of missing critical steps.

### Informed Consent

The patient should have a clear understanding of the procedure they are having done, what it entails, and the potential risks, benefits and alternatives [2]. Barriers to getting an appropriate consent may include language issues, health literacy, and the use of medical terminology [3, 4]. An appropriate consent may require having a medical interpreter, eliminating medical jargon, allowing ample time for patient questions, and ensuring patient understanding before obtaining the patient's signature [5].

### The Universal Protocol

Pain clinics tend to move at a fast pace and it is critical to follow the Universal Protocol adopted by JHACO to avoid errors of wrong site, wrong procedure, and wrong patient [6]. Just before starting the procedure, the patient's name, procedure being done, side of the procedure, and matching information on the consent should be confirmed. This process was initially developed to avoid surgical errors, but the same concerns apply to bedside procedures. It is not known the rate at which these errors occur during bedside procedures, but the risk can be minimized by following the Universal Protocol every time [7].

### Hand Hygiene

Hand hygiene can include handwashing with an antiseptic wash, alcohol-based hand rubs, or surgical hand wash [8, 9]. For alcohol-based rubs to be effective the solution must contact all surfaces of the hand. For handwashing with soap and water, hands should be rubbed vigorously together for 15 s after the application of soap under lukewarm water, then dried completely [8]. Before a bedside procedure, an alcohol-based hand rub should be used before wearing gloves. An alcohol-based hand rub should then be used again after removing gloves at the end of the procedure and again before contact with the next patient [9].

### Procedure Site Antisepsis

Procedure site and skin antisepsis are critical for preventing surgical and procedure site infections. The most common agents employed for skin antisepsis are chlorhexidine gluconate and iodophors solutions in either alcohol-based or aqueous-based

solvents [10]. Alcohol-based compounds are superior to aqueous-based ones [11]. The only exception would be if the procedure were to occur on a mucosal surface in which case the only safe solution to use is an aqueous-based iodophor [11].

---

### 3 Adverse Events During Bedside Procedures

All procedures carry a risk of adverse events, thus all clinicians performing procedures must have deep knowledge and understanding of the specific adverse events for each procedure.

#### Provider Needlestick

The National Institute for Occupational Safety and Health (NIOSH) estimates that between 600,000 and 800,000 needle stick injuries occur every year [12]. The estimated seroconversion rate after a needlestick injury from an infected patient is approximately 30% with HBV, 1.8% with HCV, and 0.3% with HIV [13]. Recapping a used needle, transferring body fluid between containers, and not disposing of used needles in proper storage containers are the most common times when a needle stick injury occurs.

Both the source patient and the employee should be tested for HBC, HCV, and HIV, with their consent. Post-exposure prophylaxis for HBV and HIV may be needed [13].

#### Infection

There are no specific studies on the risk of infection in bedside pain procedures. A survey by Surgical Outcomes Information Exchange in 2010 of pain management clinics at ASC's reported no infections from around the country. This may be due to the minimally invasive nature of most bedside procedures. However, universal precautions and proper antisepsis should always be followed.

#### Peripheral Nerve Injury

Peripheral nerve injury after nerve blocks can be divided into mechanical or traumatic injury from the procedure (such as intraneural injection), toxic injury from the injected medication (as with highly concentrated solutions), and ischemic injury from vascular supply disruption to the nerve [14, 15]. The most significant factors for the risk of nerve injury are pre-existing nerve damage, location of the needle tip at the time of injection as well as the opening injection pressure [16].

Multiple steps can be taken to help prevent peripheral nerve injury. Ultrasound can show the presence of intra-neural injection but has not been shown consistently to reduce the incidence of peripheral nerve injury [15]. Longer bevel and wider

diameter needles are more likely to cause a nerve injury [15]. Finally, preexisting peripheral neuropathy or spinal canal stenosis and procedure positioning can also increase the risk of a peripheral nerve injury [17]. If the patient reports paresthesia or intense pain with injection, the injection needs to be stopped and the needle should be adjusted even if the ultrasound picture looks appropriate. The patient is the first and best indicator of an intra-neural injection.

## **Pneumothorax**

Procedures done in the thoracic region carry a risk of pneumothorax. These include intercostal nerve blocks, trigger point injections, PECS blocks, serratus plane blocks, and brachial plexus blocks via the supraclavicular approach. Before the use of ultrasound technology, the incidence of pneumothorax from these blocks was estimated as high as 6%. However, the use of ultrasound has reduced the incidence to 0.06%, a 100-fold reduction [18]. Skillful ultrasound guidance is key, and the needle should be seen clearly and accurately during the entire procedure to avoid causing a pneumothorax.

Patients reporting dyspnea and nothing evidence of hypoxia after a thoracic procedure should be evaluated. 100% oxygen should be administered and a chest radiograph obtained. Most can be treated conservatively, but more severe cases may require a chest tube placement, hospitalization, and potential ICU stay.

## **Vascular Injection and LAST**

Local Anesthetic Systemic Toxicity, or LAST, can occur from a vascular injection of local anesthetic. The American Society of Regional Anesthesia provides updated practice advisories and checklists for suspected LAST [19]. LAST should be suspected in any patient with acute neurologic changes and/or hemodynamic instability following the injection of a local anesthetic. There are no measures to prevent LAST. Ultrasound can reduce the risk, but doesn't eliminate it. To minimize the risk, use the lowest effective dose of local and inject incrementally. Aspiration carries an approximately 2% false-negative rate, so direct visualization on ultrasound may be the most effective way.

Maintain the patient's airway with 100% oxygen and assisted ventilation if needed. Seizures should be treated with benzodiazepines. Hypotension and bradycardia should be treated. Advanced Cardiac Life Support (ACLS) may be necessary. Finally, a 20% lipid emulsion therapy should be initiated as soon as possible with a weight-based bolus followed by an infusion. In the case of ACLS measures, epinephrine doses should be reduced to less than 1  $\mu\text{g}/\text{kg}$ . Propofol is not useful in LAST since it's more dilute than the lipid emulsion and it won't be as effective, and it may lead to further cardiovascular instability.

## 4 Conclusion

Interventional procedures carry an inherent risk that cannot be eliminated, but the risk can be minimized by cleaning one's hands and injection sites, being up-to-date on the latest and safest ways to perform procedures, and recognizing complications unique to each procedure.

---

## References

1. Committee on Quality Health Care in America IoM. Crossing the quality chasm: a new health system for the 21st century. Washington, DC: National Press Academy; 2001.
2. Kinnnersley P, Phillips, K, Savage, K, Kelly, MJ, Farrell, E, Morgan, B, Whistance, R, Lewis, V, Mann, MK, Stephens, BL, Blazeby, J, Elwyn, G, Edwards, AGK. Interventions to promote informed consent for patients undergoing surgical and other invasive healthcare procedures (Review). The Cochrane Library. 2013(7).
3. Schyve P. Language differences as a barrier to quality and safety in health care: the Joint Commission perspective. *J Gen Intern Med.* 2007;22(2):1.
4. Schenker Y, Fernandez A, Sudore R, Schillinger D. Interventions to improve patient comprehension in informed consent for medical and surgical procedures: a systematic review. *Med Decis Making.* 2011;31(1):23.
5. Schenker Y, Meisel A. Informed consent in clinical care: practical considerations in the effort to achieve ethical goals. *JAMA.* 2011;305(11):1.
6. The Joint Commission. Universal protocol. [https://www.jointcommission.org/standards\\_information/up.aspx](https://www.jointcommission.org/standards_information/up.aspx). Published 2019. Accessed 29 Nov 2019.
7. Kwaan M, Studdert DM, Zinner MJ, Gawande AA. Incidence, patterns, and prevention of wrong-site surgery. *Arch Surg.* 2006;141(4):5.
8. Healthcare Infection Control Practices Advisory Committee. Guideline for hand hygiene in health-care settings. *MMWR.* 2002;51(RR-16):48.
9. World Health Organization. Global guidelines on the prevention of surgical site infection. <https://www.who.int/gpsc/ssi-prevention-guidelines/en/>. Published 2016. Accessed 29 Nov 2019.
10. Berrios-Torres S, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al. Centers for Disease Control and Prevention guideline for the prevention of surgical site infection, 2017. *JAMA Surg.* 2017;152(8):8.
11. Hemani M, Lepor H. Skin preparation for the prevention of surgical site infection: which agent is best? *Rev Urol.* 2009;11(4):6.
12. US Public Health Service. Updated U.S. Public Health Service guidelines for the management of occupational exposures to HBV, HCV, and HIV and recommendations for postexposure prophylaxis. *MMWR.* 2001;50(RR11):42.
13. Center for Disease Control. Updated guidelines for antiretroviral postexposure prophylaxis after sexual, injection drug use, or other nonoccupational exposure to HIV—United States, 2016. <https://www.cdc.gov/hiv/pdf/programresources/cdc-hiv-npep-guidelines.pdf>. Published 2016. Accessed 29 Nov 2019.
14. Hogan Q. Pathophysiology of peripheral nerve injury during regional anesthesia. *Reg Anesth Pain Med.* 2008;33(5):7.
15. Brull R, Hadzic A, Reina MA, Barrington MJ. Pathophysiology and etiology of nerve injury following peripheral nerve blockade. *Reg Anesth Pain Med.* 2015;40(5):12.
16. Steinfeldt T, Nimphius W, Werner T, Vassiliou T, Kill C, Karakas E, Wulf H, Graf J. Nerve injury by needle nerve perforation in regional anaesthesia: does size matter? *Br J Anaesth.* 2010;104(2):9.

17. Hebl J, Kopp SL, Schroeder DR, Horlocker TT. Neurologic complications after neuraxial anesthesia or analgesia in patients with preexisting peripheral sensorimotor neuropathy or diabetic polyneuropathy. *Anesth Analg.* 2006;103(5):6.
18. Gauss A, Tugtekin I, Georgieff M, Dinse-Lambracht A, Keipke D, Gorsewski G. Incidence of clinically symptomatic pneumothorax in ultrasound-guided infraclavicular and supraclavicular brachial plexus block. *Anaesthesia.* 2014;69(4):10.
19. Neal J, Barrington MJ, Fettiplace MR, Gitman M, Mementsoudis SG, Mörwald EE, Rubin DS, Weinberg G. The Third American Society of Regional Anesthesia and Pain Medicine practice advisory on local anesthetic systemic toxicity: executive summary 2017. *Reg Anesth Pain Med.* 2018;43(2):11.

---

## Further Reading

Morello RT, Lowthian JA, Barker AL, McGinnes R, Dunt D, Brand C. Strategies for improving patient safety culture in hospitals: a systematic review. *BMJ Qual Saf.* 2013;22(1):11–8. <https://doi.org/10.1136/bmjqs-2011-000582>. Epub 2012 Jul 31. PMID: 22849965.