Perioperative Pain Management for Upper Extremity Surgery

Alexander C. Coleman, MD

KEYWORDS

• Anesthesia • Upper extremity • Wide-awake local anesthesia
• Local anesthesia with intravenous sedation • Intravenous regional block

KEY POINTS

- Anesthesia options range from general anesthesia to wide-awake local anesthesia.
- Anesthesia choice must be individualized for each patient.
- Patient factors to be considered include disease process and comorbidities.
- Procedure-related factors to consider include anatomic location and complexity and duration of the procedure, as well as postoperative pain expectations.

HISTORY OF UPPER EXTREMITY ANESTHESIA

The past 2 centuries have seen the rapid growth of effective pain control during and after upper extremity surgery. During the mid–eighteenth century, the happy coincidence of Dr Morton's introduction of ether as a general anesthetic and Dr Fergusson's development of the open palmar fasciectomy allowed what was likely the first hand surgery ever performed under general anesthesia.[1] This groundbreaking procedure occurred in 1846 and the advances in perioperative pain management have continued to this day.

Upper extremity surgeons are now faced with a daunting array of anesthesia techniques, ranging from traditional general anesthetic to wide-awake surgery, during which patients can watch their surgeons operate in the morning and return to work as soon as that afternoon. Because of this range of options, surgeons must develop an algorithm that sorts patients by disease process, relevant comorbidities, and procedure type to ensure each patient receives the most appropriate anesthetic option.

ANESTHESIA SELECTION

As a general rule, at our institution, the approach to upper extremity anesthesia care is to use local anesthesia if possible, and general anesthesia if necessary. The algorithm is simple. Surgeons assess the procedure and try to determine the least invasive anesthesia technique possible. There are multiple factors that go into this process:

1. What is the overall health status of the patient and what type of anesthesia will the patient tolerate?
2. What are the anatomic considerations of the procedure and what interventions will be needed to totally anesthetize that body part?
3. What is the duration of the procedure and will a tourniquet be required?
4. How painful will the procedure be, and what is the plan for postprocedure pain control?

Answering these basic questions aids surgeons in selecting the most effective and least invasive technique possible. It is also helpful to create broad anesthesia categories and then stratify them by invasiveness and relative risk to the patient. These categories are listed here in

Disclosures: None.
Andrews Institute for Orthopaedics & Sports Medicine, 1040 Gulf Breeze Pky, #200, Gulf Breeze, FL 32561, USA
E-mail address: colemanac@gmail.com

Orthop Clin N Am 48 (2017) 487–494
http://dx.doi.org/10.1016/j.ocl.2017.06.009

order of increasing invasiveness or anesthetic risk:

- Wide-awake local (no sedation)
- Local with intravenous (IV) sedation (local and monitored anesthesia care [MAC])
- IV regional (Bier block)
- Regional block (plexus block)
- General anesthesia

Local Only

In 1884, the German ophthalmologist Carl Koller discovered that, when he placed cocaine on his tongue, it quickly went numb.[2] He rapidly made the connection between drug and effect and introduced the use of cocaine as a local anesthetic to the practice of medicine. This development, inauspicious as it may seem with the benefit of hindsight, signaled the dawn of the era of modern anesthesia. Novocaine was discovered in 1905 and soon thereafter epinephrine was added to the armamentarium.

Local-only anesthesia is typically achieved by infiltration of an anesthetic agent at or near the site of a surgical procedure. This anesthesia can be accomplished either through a field block or by anesthetizing the nerves that service the surgical site. Two of the most common applications are local infiltration for trigger finger release or a digital nerve block for nail bed repair.

Local anesthesia has the advantage of avoiding any sedatives or narcotics. This advantage makes it attractive for patients with medical comorbidities or contraindications to anesthesia. It is also attractive to busy patients who do not want to take time off from work or who wish to drive themselves to and from the procedure. Disadvantages include pain associated with the injection, lack of sedatives for nervous patients, and the inability to use a forearm or arm tourniquet for more than 20 to 30 minutes. Another potential disadvantage of local infiltration is the presence of additional fluid at the surgical site, which can distort the anatomy and make visualization of critical structures more challenging.

Local with Intravenous Sedation

Many of the disadvantages of local-only anesthesia can be mediated through the judicious administration of IV sedatives and analgesics. Local anesthesia with sedation, or local MAC, provides a good balance of patient comfort, operative flexibility, and anesthetic risk. Although sometimes performed in the office setting, most orthopedists prefer to use this type of anesthesia in the operating room or ambulatory surgery center setting under the supervision of an anesthesiologist or certified registered nurse anesthetist. The addition of sedation has several distinct advantages. It provides comfort for anxious patients, helps alleviate the discomfort associated with anesthetic injection, and typically allows a longer tourniquet time. The level of sedation can also be incrementally increased if the patient is not tolerating the procedure. The primary drawbacks include the need for additional personnel in the form of an anesthesia team, increased cardiopulmonary risk and postoperative nausea, and the need for a caretaker to drive the patient home and observe the patient after surgery.

Intravenous Regional Anesthesia

German surgeon August Bier first described the use of IV regional anesthesia in 1908, but it did not gain widespread popularity until it was reintroduced in 1968 by Holmes.[3] The concept is simple. The operative extremity is completely exsanguinated and a tourniquet is inflated. The venous system is then back-filled with a large volume of local anesthetic, which diffuses throughout the distal extremity producing effective regional anesthesia. In the past, a double tourniquet was used over the brachium to allow longer tourniquet times by allowing for an additional site of tourniquet compression during the procedure. The primary disadvantage of this technique is the volume of anesthetic and the time required to administer the block, both of which can lead to delays in turnover. If a tourniquet is deflated prematurely, the large volume of anesthetic required for a Bier block can cause systemic toxicity.

At our institution, Bier block anesthesia is used on a routine basis. We overcome the problems mentioned earlier with the following modifications. First, the IV line for the block is placed in preoperative holding to save operating room time. We have also shifted to the use of a single-bladder forearm tourniquet with a significantly reduced volume of local anesthetic, thus allowing safe deflation of the tourniquet at any time during the procedure. Regardless of technique, IV regional anesthesia requires the use of a tourniquet in an awake or mildly sedated patient and thus can only be used for limited duration because of tourniquet pain. For this reason, it is best reserved for shorter procedures.

Regional Anesthesia (Plexus Blocks)

German surgeon Diedrich Kulenkampff is credited with performing the first percutaneous brachial plexus block in 1911.[4] He reportedly