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CASE REPORT

Continuous Local Anesthetic Infiltration

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New technology enables patient control of anterior cruciate ligament postoperative pain.

The trend in the last 10 years toward more outpatient surgery and faster rehabilitation has created more interest in methods of postoperative pain control that will decrease the dependency on narcotics and their adverse effects such as drowsiness, nausea, constipation, and malaise. Various techniques have been evaluated such as local infiltration of anesthetics, peripheral nerve block, epidural injections, and use of non-narcotic medications. It has become a common practice at the end of a knee or shoulder procedure to place a bolus injection of a local anesthetic such as bupivacaine to assist in the postoperative pain control.[1] There is some evidence to suggest the anesthetic effect may be extended for several hours with the addition of intra-articular morphine at the time of the local anesthetic infiltration.[2,3]

The optimal method of postoperative pain control would continue for at least 48 hours, minimize narcotic usage, entail minimal risks, and allow outpatient administration. Continuous administration of local anesthetic for 48 hours or more can be achieved with disposable infusion pumps that use balloon pressure to force local anesthetics such as bupivacaine at a constant rate through a 20-gauge catheter into the operative site. These devices are used on various orthopedic procedures such as anterior cruciate reconstruction, shoulder arthroscopy, rotator cuff repair, or total knee arthroplasty.

Figure 1. Patellar tendon closure over catheter

A typical infusion system is placed on a shoulder. The catheter, filter, and rate-limiting device are taped to the skin. The potential efficacy for this technique was first demonstrated by William Mallon, MD, in 1994 using an inpatient pump for rotator cuff repair. His study found an approximately 30% reduction in the requirements for narcotic pain medications and reduced pain levels. Savoie found similar results in a prospective, randomized, double-blind study of arthroscopic subacromial decompression.[4]

Two double-blind placebo-controlled studies completed at Scripps Clinic, La Jolla, Calif, evaluated the use of these devices for knee procedures. Twenty-six patients received either 2 mL per hour of 0.25% bupivacaine or saline for 48 hours after anterior cruciate ligament reconstruction. All patients received a bolus injection of 25 mL of 0.25% bupivacaine with 5 mg of morphine at the end of the procedure. The pumps were removed by the patient at home or at the first physical therapy visit. The results demonstrated a 30% reduction in pain on a visual analog scale. There was a trend suggesting a 35% reduction in narcotic usage. A second study evaluated 20 patients undergoing total knee arthroplasty who received bupivacaine or saline infusion at 5 mL per hour for 48 hours. Results demonstrated narcotic consumption was reduced by a third. There were no infections related to the catheter. The technique was well received by the patients.

Catheter Placement Technique

Most of the failures of this technique involve incorrect placement or dislodgement of the catheter from the wound site. It is important to place the catheter under direct or arthroscopic visualization. The catheter then needs to be immediately taped in place and flushed with saline or bupivacaine to keep it from clotting off.

The placement site for shoulder rotator cuff repair is usually in the subacromial space through the anterior deltoid. The catheter entrance site should avoid the cephalic vein, arthroscopic portals, or incision site. If the catheter is placed through the posterior deltoid, leakage of the fluid around the catheter may be noted when the patient is supine. For intra-articular labral or capsular repairs, the catheter may be placed in the glenohumeral joint through the rotator interval.

For anterior cruciate ligament reconstruction, the catheter can be placed intra-articular or at the patellar tendon donor site. Recent information on neurosensory mapping of the knee suggests that the anterior knee is very sensitive in relation to other sites.[5] It is for this reason that we have placed the catheter in the patellar tendon defect for anterior cruciate ligament reconstruction (See Figure 1). Further studies may be helpful to determine optimal catheter placement sites. For hamstring reconstruction, the catheter is placed intra-articular.

Anesthetic Toxicity

A primary consideration for the use of bolus and continuous infusion of a local anesthetic is to minimize the risk of toxic side effects of the anesthetic agent. Bupivacaine is a commonly used agent for its long duration of action (4 to 6 hours) but at toxic doses can cause CNS or cardiac side effects such as cortical irritation, seizures, or arrhythmias that can be fatal. It is very important to avoid intravascular injection.

The Physicians' Desk Reference information on bupivacaine suggests a maximum bolus injection of 225 mg if combined with epinephrine or 175 mg without epinephrine. A study done by Wasudev[6] I et al found that, when given a 30-mL bolus of 0.75% bupivacaine (225 mg), four out of 30 patients undergoing knee arthroscopy demonstrated toxic serum levels although they did not experience toxic symptoms. He found that synovectomy increased the serum levels that were observed. On the basis of this finding, he recommended no more than 150-mg initial bolus of bupivacaine. Therefore, if using 0.25% bupivacaine, one should inject no more than 60 mL of anesthetic or 30 mL if using 0.5% anesthetic.

When combining a bolus injection with a continuous infusion, one has to consider the dosage that occurs over a 24-hour period. The Physicians' Drug Reference recommends no more than 400 mg over a 24-hour period. Commonly used continuous rates are 2 mL or 5 mL per hour. Table 1 outlines the expected dosage that one may receive when considering bolus and continuous infusion rates together over a 24-hour period.

From Table 1, it can be seen that the continuous infusion should be limited to 2 mL per hour if using 0.5% bupivacaine in order to keep the total 24-hour dosage below 400 mg.

24-Hour Infusion Bupivacaine
0.5% @ 2 mL/hr = 240 mg
0.5% @ 30 mL = 150 mg
Total for 24 hr = 390 mg
0.25% @ 5 mL/hr= 300 mg
0.25% @ 30 mL = 75 mg
Total for 24 hours = 375 mg

Table 1

The higher concentrations of bupivacaine are typically used for peripheral nerve blocks in order to obtain a better motor block. That is, doubling the concentration may not provide a corresponding increase in sensory efficacy to justify the increased potential for toxic side effects. Further studies need to be done to evaluate the effect of increasing flow versus the concentration of anesthetic. A surgeon may choose to increase the flow from 2 mL to 5 mL per hour to infiltrate larger areas. However, if the 5 mL per hour rate is chosen, it is recommended to keep the concentration of bupivacaine at 0.25% to minimize possible toxic side effects. It has been the practice in our clinic to use a 0.25%

concentration of bupivacaine regardless of the flow rate chosen.

There are newer local anesthetic agents such as ropivacaine and levobupivacaine that have a much higher threshold for cardiac side effects. These agents may allow larger bolus injections and higher flow rates for larger wounds.

No toxic effects of bupivacaine on articular cartilage have been reported. One study of bolus injection of bupivacaine and saline injection demonstrated a transient inhibition of sulfate uptake by chondrocytes. This temporary effect appeared to be primarily related to the saline effect on articular cartilage.[7]

Patient Education

These continuous infusion devices can be used on an outpatient basis and in our experience can be removed at home by the patient or the therapist on the first postoperative visit. It is essential, however, that the patient receive a detailed explanation of the device. This should be done at the preoperative visit and should include written instructions on how and when to remove the catheter. If the device becomes disconnected or clogged, or leaks, it should be removed. Although some patients may have initial apprehension, once they have seen the device and received instructions, it actually seems to reduce their overall anxiety about the surgical procedure.

Complications

The most common problems with this technique involve dislodgement of the catheter, leaking of the catheter connection, or clogging of the catheter. Review of the literature and this author's experience of use of this technique in 500 patients failed to reveal any toxic effects of the local anesthetic or any infections related to the catheter. No wound healing problems have been reported.

Summary

Several literature studies have supported the use of continuous infusion of local anesthetics to augment traditional narcotic use in the treatment of postoperative pain. It is well received by patients and hospital personnel. It can be used with a low risk of complications and adverse side effects. Further studies will determine the optimal anesthetic agents, flow rate, and placement sites of the catheter.

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