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The management of pain plays an important role in postoperative rehabilitation and surgical outcome. Numerous analgesic options are available including opioid and non-opioid systemic analgesics, central neuraxial as well as peripheral regional anesthetic techniques, as well as various physical modalities. The goal is to alleviate pain and improve quality of care, to attenuate the harmful effects of pain, to reduce morbidity, and to facilitate rehabilitation. Chung et al. quantified the failure of outpatient pain management by noting that after some orthopedic, urologic, and plastic procedures, the incidence of severe postoperative pain varied between 40% and 70%[1]. This lecture will explore the value of continuous regional analgesia (CRA) in meeting the goals of optimal pain management.

Opioid analgesics are effective in controlling moderate to severe pain, however, their use is associated with numerous side effects that may prolong hospital stay and result in unanticipated admission of ambulatory patients. The result includes an increase in cost and a decrease in patient satisfaction. Intravenous patient-controlled analgesia is more effective than intermittent intramuscular or intravenous boluses but its benefits need to be balanced against those of opioid-related side effects as well as operator and mechanical errors.

Central neuraxial analgesia is effective but is also limited by opioid as well as local anesthetic associated side effects, technical issues, and is labor intensive. In addition, epidural analgesia is not commonly used for upper extremity surgery and may be contraindicated in certain situations. In particular, the risk of spinal hematoma in patients receiving low-molecular-weight heparin has led to a search for alternate techniques of providing postoperative analgesia.

Peripheral nerve blocks provide an attractive alternative as they are not associated with opioid-related side effects nor are they contra-indicated in patients receiving anticoagulants with the exception of certain sites[2]. The primary limitation of these techniques is related to the limited duration of a single injection technique (10-24 hours) and the moderate to severe pain the may follow resolution of the block[3]. This problem has been overcome by the introduction of CRA. These techniques are being used to provide prolonged site-specific surgical anesthesia, postoperative analgesia, as well as in the management of chronic pain and upper extremity ischemia. The success and safety of CRA has resulted in patients being discharged home with a perineural catheter in situ[4,5]. Placement of the catheter is determined by the operative procedure and includes upper and lower extremity perineural placement as well as intra-articular, incisional, and paravertebral catheters.

The current availability of equipment (needles and catheters) to facilitate catheter placement, disposable infusion pumps for ambulatory patients, and studies demonstrating the advantages and safety of these techniques has resulted in an upsurge of interest in the use of CRA[3,6-9].

Borgeat et al.[10] studied 40 patients undergoing major shoulder surgery using a combined technique. The patients received an interscalene block with ropivacaine 0.75%, an interscalene catheter was secured, followed by a standardized general anesthetic. Postoperatively the patients were randomized into two postoperative analgesia groups: Group 1 received intravenous patient-controlled analgesia and Group 2 received patient-controlled regional analgesia (bupivacaine 0.15% at 5 ml/h plus patient-controlled boluses of 3-4 ml *q* 20 minutes). On postoperative day-1 the PCRA group reported significantly less pain, less use of supplementary medications and greater satisfaction with their pain control than Group 1. The authors concluded that PCRA provided superior analgesia with few side effects, and with the added advantage of the ability to reinforce the block prior to physical therapy. In a randomized, double-blinded, placebo-controlled study, Ilfeld et al[6] studies 30 patients undergoing surgery at or below the elbow under regional anesthesia. All patients received and infraclavicular block with ropivacaine 0.5% plus epinephrine. Postoperatively, half the patients received a continuous infusion of ropivacaine 0.2% at 10 ml/h, while the other half received an infusion of nor-

mal saline. Patients were discharged home and the catheter remained *in situ* for 3 days. The ropivacaine group reported significantly less pain at rest and with movement as well as significantly less oral narcotic use for the entire 3-day period. In addition, the patients reported a decrease in sleep disturbance as well as an increase in overall satisfaction. Numerous additional studies have conformed the success rates (75% to 100%), as well as the benefits of upper extremity CRA[11-17]. Complications, while rare, have been reported[16,18-23].

Postoperative epidural analgesia has been regarded as the gold standard following lower extremity surgery. However, contraindications to its use exist as do a number of disadvantages. Needle and catheter insertion are not risk-free, opioid and local anesthetic side effects are ever-present, appropriate monitoring is essential, and technical issues are not an uncommon problem. CRA provides a safe and effective alternative following lower extremity surgery. Singelyn et al[24] studied postoperative pain control and knee rehabilitation following total knee arthroplasty. Forty-five patients scheduled for TKA under general anesthesia were divided into 3 postoperative analgesia groups: Group A received IV morphine PCA, Group B received CRA via a femoral nerve catheter and Group C received epidural analgesia. Both groups B and C received the same infusion of bupivacaine 0.125% + sufentanil 0.1 μg/ml + clonidine 1 μg/ml at 10 ml/h. Groups B and C provided more effective pain control and, as a result, improved postoperative knee rehabilitation when compared with Group A. In addition, the CRA group reported less side effects and catheter problems than did the epidural group. As with the upper extremity, numerous recent reports have confirmed the advantages of CRA over conventional (IV-PCA and epidural analgesia) postoperative analgesic techniques[25-30]. Continuous posterior lumbar plexus blocks have, however been associated with a number of complications including renal subscapular hematoma[31], psoas hematoma and lumbar plexopathy[32], extensive retroperitoneal hematomas[2], as well as total spinal anesthesia[33].

A number of authors have attempted to determine the "optimal" technique for providing prolonged CRA, i.e. continuous infusion, intermittent boluses, or continuous basal infusion plus patient-controlled boluses[13,27,34]. In summary, these studies report that intermittent boluses provide absolute control at the cost of convenience and break through pain, continuous infusions are simple and convenient but may also suffer the disadvantage of break through pain after 12-24 hours, whereas a continuous infusion accompanied by patient-controlled boluses is the most titratable and results in the lowest consumption of local anesthetic. In addition, patients report improved rehabilitation, greater pain control with less side effects and increased satisfaction.

The placement of intra-articular, incisional, and paravertebral catheters have also been effective in providing prolonged postoperative pain relief[7,35-38]. The benefit of placing and intra-articular over a perineural catheter is however questionable. While the former is a simpler process, the majority of studies report improved pain control with perineural catheters[39-43]. On the other hand, both incisional as well as paravertebral catheter placement have been shown to be extremely effective and safe techniques of providing postoperative analgesia following a variety of surgical procedures[7,35-38].

The increased use of CRA has largely been a result of the availability of needle-catheter kits that facilitate catheter placement, disposable infusion pumps, and less toxic local anesthetic agents. A number of needle-catheter kits are available to which a peripheral nerve stimulator can be attached to aid needle placement. A further advancement is the availability of stimulating catheters that allow immediate confirmation of correct catheter placement[44,45]. Numerous non-disposable as well as disposable infusion pumps are available. Ilfeld et al. reported on the accuracy of these pumps over a fixed time period and demonstrated that not all pumps are equal[46].

Bupivacaine has been the gold standard of long-acting local anesthetics for many decades. Its position is however being challenged by ropivacaine and levobupivacaine. Ropivacaine is less cardiotoxic and demonstrates greater sensory-motor dissociation[47]. This latter property is of great benefit postoperatively as analgesia can be achieved with a lower incidence of unwanted motor blockade thus allowing the patient to actively participate in their postoperative rehabilitation[48]. In addition, the offset of any motor blockade is more rapid. Levobupivacaine is virtually identical to bupivacaine with the exception that it too is less cardiotoxic[49]. There are no published clinical trials that demonstrate that the addition of adjuvants (e.g. opioids, clonidine, etc.) offers any clear advantage over the use of local anesthetics alone for CRA. There are also no clear guidelines regarding the optimal infusion rate, bolus dose or lockout interval (Table I).

Table I. Continuous regional analgesia: Guidelines.

Local anesthetic	Concentration (%)	Infusion rate	Bolus Dose (ml)	Lockout (min)
Bupivacaine	0.125 – 0.25	5 – 15 ml/h 0.125 – 0.25 mg/kg/h	2 - 5	20 - 30
Ropivacaine	0.2	"	"	"
Levobupivacaine	0.25	"	"	"

Potential complications associated with the use of CRA are similar to those associated with peripheral nerve blockade, however, these have proven to be few and far between. This may be a reflection of the fact that in most cases these catheters are placed by individuals experienced in the use of regional anesthetic techniques. The potential for infection is an issue that has been raised and proven to be unfounded. Cuvillon et al. (50) analyzed 208 femoral catheters that were removed 48 hours after insertion as well as 6 weeks later. Bacterial colonization was positive in 57% of catheters (Staph. Epidermidis 71%, Enterococcus 10%, Klebsiella 4%). None of the patients demonstrated any evidence of cellulites or abcess formation. A similar lack of local or systemic infection following axillary catheterization was reported by Gaumann et al[51]. The antibacterial activity of aminoamide local anesthetics may be partially responsible[52].

In summary: Continuous regional analgesia has few, if any contraindications, provides excellent localized analgesia with minimal side effects, requires no specific monitoring (compared with central neuraxial analgesia), is associated with minimal risk, and results in excellent patient satisfaction and rehabilitation. The feasibility and safety of CRA in ambulatory patients has been established[3,6-8,30]. Patient selection, clear verbal and written instructions, follow-up telephone call, and 24-hour access to anesthesiology services are prerequisites for PCRA at home[3,7,53].

TIPS ON CATHETER PLACEMENT FOR CONTINUOUS REGIONAL ANESTHESIA

(Kayser Enneking, Gainsville, Florida – modified)

Orient the bevel of the introducing needle along the same axis as the nerve. Then approach the nerve at the least acute angle.

With the needle ideally placed, inject a mass of local anesthetic, or normal saline to open up the fascial compartment (This author's preference is to achieve complete blockade at this point). This maneuver can also be tried if the catheter is not threading easily after passing the tip of the needle. Inject 3-5 ccs of fluid through the catheter to open up the space then try again to advance the catheter.

Introduce the catheter firmly, however if it does not thread don't force and kink the catheter. Instead, try to lower the angle of the introducing needle, or change the orientation of the bevel of the introducing needle.

After the catheter has been successfully threaded secure it! Numerous methods have been described including sutures, steri-strips and/or tunneling under the skin.

Make sure to inject additional fluid (This author prefers a local anesthetic solution) through the catheter after it is placed to ensure its patency. It is much easier to adjust the catheter when you first place it than later.

The patient should be given an appropriate loading bolus of local anesthetic to initiate the block (either initially through the needle, or later via the catheter).

The continuous infusion is usually started 2-4 hours after the initial loading bolus depending on the initial local anesthetic used. The local anesthetic solution (0.25% bupivacaine, 0.2% ropivacaine, or 0.25% levobupivacaine) is infused at a rate of 4-6 cc/hour with a 2 cc patient controlled bolus every 30 minutes. If patient controlled bolus mode is not available, a higher basal infusion rate will be a required.

INSTRUCTIONS FOR CONTINUOUS CATHETER PATIENTS

(Kayser Enneking, Gainsville, Florida)

You are receiving local anesthetic through a small catheter near your nerves to help with your pain after surgery. This may not take away all of your pain but should help greatly. You may take your pain medicines as prescribed by your doctor. The nurse will review this with you. The local anesthetic will initially make your arm or leg very numb. Over time, this degree of numbness will decrease but usually your arm/leg is not normal until the catheter is removed. Because your arm or leg won't function normally, *YOU SHOULD NOT DRIVE*.

The doctors and nurses will review the pump instructions with you. If you have any problems with the pump call the technical support number or the number the doctor has given you.

Complications that could potentially occur include:

The catheter may fall out. If this occurs make sure to take some of your pain medicine and turn the pump off.

Fluid may leak around the catheter. You can change or reinforce the dressing if necessary. This is usually not a problem.

The catheter may migrate into a blood vessel and cause high levels of local anesthetic. Symptoms of high levels of local anesthetic may include:

Drowsiness
Dizziness
Blurred vision
Slurred speech
Poor balance
Tingling around lips/mouth
Other

If you have a leg catheter you

Should not walk without crutches or someone helping

Should keep your immobilizer or splint on unless doing therapy.

If you have an arm catheter you should keep your arm in a sling unless doing therapy.

Call your physician for medical assistance if any of the following symptoms occur:

Unusual drowsiness
Uncontrollable pain
Uncontrollable vomiting.

REFERENCES

1. Chung F, Mezei G. Adverse outcomes in ambulatory anesthesia. Can J Anaesth 1999;46:R18-34.
2. Weller RS, Gerancher JC, Crews JC, Wade KL. Extensive retroperitoneal hematoma without neurologic deficit in two patients who underwent lumbar plexus block and were later anticoagulated. Anesthesiology 2003;98:581-5.
3. Klein SM. Beyond the hospital: continuous peripheral nerve blocks at home. Anesthesiology 2002;96:1283-5.
4. Grant S, Nielsen K, Greengrass R, et al. Continuous peripheral nerve block for ambulatory surgery. Reg Anesth Pain Med 2001;26:209-14.
5. Ilfeld BM, Esener DE, Morey TE, Enneking FK. Ambulatory perineural infusion: the patients' perspective. Reg Anesth Pain Med 2003;28:418-23.
6. Ilfeld BM, Morey TE, Enneking FK. Continuous infraclavicular brachial plexus block for postoperative pain control at home: a randomized, double-blinded, placebo-controlled study. Anesthesiology 2002;96:1297-304.
7. Rawal N, Allvin R, Axelsson K, et al. Patient-controlled regional analgesia (PCRA) at home: controlled comparison between bupivacaine and ropivacaine brachial plexus analgesia. Anesthesiology 2002;96:1290-6.
8. Klein S, Nielsen K, Greengrass R, et al. Ambulatory discharge after long-acting peripheral nerve blockade: 2382 blocks with ropivacaine. Anesth Analg 2002;94:65-70.
9. Klein S, Pietrobon R, Nielsen K, et al. Peripheral nerve blockade with long-acting local anesthetics: a survey of The Society for Ambulatory Anesthesia. Anesth Analg 2002;94:71-6.
10. Borgeat A, Tewes E, Biasca N, Gerber C. Patient-controlled interscalene analgesia with ropivacaine after major shoulder surgery: PCIA *vs* PCA. Br J Anaesth 1998;81:603-5.
11. Borgeat A, Schappi B, Biasca N, Gerber C. Patient-controlled analgesia after major shoulder surgery: patient-controlled interscalene analgesia *versus* patient-controlled analgesia. Anesthesiology 1997;87:1343-7.
12. Lehtipalo S, Koskinen L-O, Johansson G, et al. Continuous interscalene brachial plexus block for postoperative analgesia following shoulder surgery. Acta Anaesthesiol Scand 1999;43:258-64.
13. Singelyn F, Seguy S, Gouverneur J. Interscalene brachial plexus analgesia after open shoulder surgery: continuous versus patient-controlled infusion. Anesth Analg 1999;89:1216-20.
14. Klein SM, Grant SA, Greengrass RA, et al. Interscalene brachial plexus block with a continuous catheter insertion system and a disposable infusion pump. Anesth Analg 2000;91:1473-8.
15. Klein S, Enneking F. Setup an outpatient continuous peripheral analgesia program at your hospital ASRA Annual Spring Meeting. San Diego, CA, 2003:311-5.
16. Borgeat A, Perschak H, Bird P, et al. Patient-controlled interscalene analgesia with ropivacaine 0.2% versus patient-controlled intravenous analgesia after major shoulder surgery: effects on diaphragmatic and respiratory function. Anesthesiology 2000;92:102-8.
17. Ilfeld BM, Morey TE, Wright TW, et al. Continuous interscalene brachial plexus block for postoperative pain control at home: a randomized, double-blinded, placebo-controlled study. Anesth Analg 2003;96:1089-95.
18. Borgeat A, Dullenkopf A, Ekatodramis G, Nagy L. Evaluation of the lateral modified approach for continuous interscalene block after shoulder surgery. Anesthesiology 2003;99:436-42.
19. Ekatodramis G, Macaire P, Borgeat A. Prolonged Horner syndrome due to neck hematoma after continuous interscalene block. Anesthesiology 2001;95:801-3.
20. Riberio F, Georgousis H, Bertram R, Scheiber G. Plexus irritation caused by interscalene brachial plexus catheter for shoulder surgery. Anesth Analg 1996;82:870-2.
21. Souron V, Reiland Y, De Traverse A, et al. Interpleural migration of an interscalene catheter. Anesth Analg 2003;97:1200-1.
22. Borgeat A, Ekatodramis G, Kalberer F, Benz C. Acute and nonacute complications associated with interscalene block and shoulder surgery. Anesthesiology 2001;95:875-80.
23. Bergman BD, Hebl JR, Kent J, Horlocker TT. Neurologic complications of 405 consecutive continuous axillary catheters. Anesth Analg 2003;96:247-52.
24. Singelyn F, Deyaert M, Joris D, et al. Effects of intravenous patient-controlled analgesia with morphine, continuous epidural analgesia, and continuous three-in-one block on postoperative pain and knee rehabilitation after unilaterial total knee arthroplasty. Anesth analg 1998;87:88-92.
25. Singelyn F, Aye F, Gouverneur J. Continuous popliteal sciatic nerve block: an original technique to provide postoperative analgesia after foot surgery. Anesth Analg 1997;84:383-6.
26. Capdevila X, Barthelet Y, Biboulet P, et al. Effects of perioperative analgesic technique on the surgical outcome and duration of rehabilitation after major knee surgery. Anesthesiology 1999;91:8-15.
27. Singelyn FJ, Vanderelst PE, Gouverneur JM. Extended femoral nerve sheath block after total hip arthroplasty: continuous versus patient-controlled techniques. Anesth Analg 2001;92:455-9.
28. Chelly JE, Greger J, Gebhard R, et al. Continuous femoral blocks improve recovery and outcome of patients undergoing total knee arthroplasty. J Arthroplasty 2001;16:436-45.
29. Capdevila X, Macaire P, Dadure C, et al. Continuous psoas compartment block for postoperative analgesia after total hip arthroplasty: new landmarks, technical guidelines, and clinical evaluation. Anesth Analg 2002;94:1606-13, table of contents.
30. Ilfeld BM, Morey TE, Wang RD, Enneking FK. Continuous popliteal sciatic nerve block for postoperative pain control at home: a randomized, double-blinded, placebo-controlled study. Anesthesiology 2002;97:959-65.
31. Aida S, Takahashi H, Shimoji K. Renal subcapsular hematoma after lumbar plexus block. Anesthesiology 1996;84:452-5.
32. Klein S, Ercole F, Greengrass R, Warner D. Enoxaparin associated with psoas hematoma and lumbar plexopathy after lumbar plexus block. Anesthesiology 1997;87:1576-9.
33. Pousman RM, Mansoor Z, Sciard D. Total spinal anesthetic after continuous posterior lumbar plexus block. Anesthesiology 2003;98:1281-2.
34. Singelyn FJ, Gouverneur JM. Extended "three-in-one" block after total knee arthroplasty: continuous versus patient-controlled techniques. Anesth Analg 2000;91:176-80.
35. Klein SM, Greengrass RA, Weltz C, Warner DS. Paravertebral somatic nerve block for outpatient inguinal herniorrhaphy: an expanded case report of 22 patients. Reg Anesth Pain Med 1998;23:306-10.
36. Klein SM, Bergh A, Steele SM, et al. Thoracic paravertebral block for breast surgery. Anesth Analg 2000;90:1402-5.
37. Coveney E, Weltz CR, Greengrass R, et al. Use of paravertebral block anesthesia in the surgical management of breast cancer: experience in 156 cases. Ann Surg 1998;227:496-501.
38. Rawal N, Axelsson K, Hylander J, et al. Postoperative patient-controlled local anesthetic administration at home. Anesth Analg 1998;86:86-9.
39. De Andres J, Monzo E. Regional techniques for day surgery: intraarticular anesthesia and analgesia. Tech Reg Anesth Pain Manag 2000;4:54-61.
40. Klein SM, Nielsen KC, Martin A, et al. Interscalene brachial plexus block with continuous intraarticular infusion of ropivacaine. Anesth Analg 2001;93:601-5.

41. Lhotel L, Fabre B, Okais I, Singelyn F. Postoperative analgesia after arthroscopic shoulder surgery (ASS): suprascapular nerve block (SSB), intraarticular analgesia (IAA) or interscalene brachial plexus block (ISB)? Reg Anesth Pain Med 2001;26(2S):34.
42. Moiniche S, Mikkelsen S, Wetterslev J, Dahl JB. A systematic review of intra-articular local anesthesia for postoperative pain relief after arthroscopic knee surgery. Reg Anesth Pain Med 1999;24:430-7.
43. Tetzlaff JE, Brems J, Dilger J. Intraarticular morphine and bupivacaine reduces postoperative pain after rotator cuff repair. Reg Anesth Pain Med 2000;25:611-4.
44. Boezaart A. Nerve stimulator assisted catheter placement for continuous plexus and nerve blocks. Hospital Supplies 2000:4-11.
45. Boezaart A, de Beer J, du Toit C, van Rooyen K. A new technique of continuous interscalene nerve block. Can J Anesth 1999;46:275-81.
46. Ilfeld BM, Morey TE, Enneking FK. The delivery rate accuracy of portable infusion pumps used for continuous regional analgesia. Anesth Analg 2002;95:1331-6.
47. Whiteside JB, Wildsmith JA. Developments in local anaesthetic drugs. Br J Anaesth 2001;87:27-35.
48. Borgeat A, Kalberer F, Jacob H, et al. Patient-controlled interscalene analgesia with ropivacaine 0.2% *versus* bupivacaine 0.15% after major open shoulder surgery: the effects on hand motor function. Anesth Analg 2001;92:218-23.
49. Foster RH, Markham A. Levobupivacaine: a review of its pharmacology and use as a local anaesthetic. Drugs 2000;59:551-79.
50. Cuvillon P, Ripart J, Lalourcey L, et al. The continuous femoral nerve block catheter for postoperative analgesia: bacterial colonization, infectious rate and adverse effects. Anesth Analg 2001;93:1045-9.
51. Gaumann D, Lennon R, Wedel D. Continuous axillary block for postoperative pain management. Reg Anesth 1988;13:77-82.
52. Hodson M, Gajraj R, Scott NB. A comparison of the antibacterial activity of levobupivacaine *vs* bupivacaine: an *in vitro* study with bacteria implicated in epidural infection. Anaesthesia 1999;54:699-702.
53. Ilfeld B. Ambulatory perineural infusions: Discharge criteria, instructions. Ambulatory Anesthesia 2002;17:5.