PERIODICUM BIOLOGORUM
VOL. 115, No 2, 131–134, 2013

UDC 57:61
CODEN PDBIAD
ISSN 0031-5362

Critical overview

Role of regional anaesthesia in postoperative pain management

SLOBODAN GLIGORIJEVIĆ

Dept of Anaesthesiology & Intensive Medicine Clinic Hirslanden, Zürich, Switzerland
E-mail: slobodan.g@bluewin.ch

Received May 15, 2013.

Anaesthesiologists made it to their business to conquer pain and are almost ruling the market of methods for perioperative pain therapy. Regional anaesthesia is today widely used for both, surgical anaesthesia and postoperative analgesia. It is not only the most efficient known method in perioperative pain therapy but is also the method capable to fit into recent changes of medical needs and environments.

However, the physicians today are not free of the obligation to justify what, why and how they practice. They have to respect evidence base data where available and to consider the cost benefit ratio as well. Outcome and evidence based medicine become intrinsically tied to anaesthesia and particularly to regional anaesthesia and pain therapy.

In other words, the anaesthesiologists are increasingly facing the question whether the properly performed, specific regional anaesthesia technique can influence surgical and or patient's outcome? The possible answer is yes, if the applied method could be shown favourable in terms of long-term sequel like immunosuppressant or favourable like improving and fastening recovery of organ functions. No, if in the whole complexity of postoperative course, one or another non-anaesthesia-related factor commence to play a decisive role rendering other achieved benefits less important.

Provision of high-quality postoperative analgesia has become recognized as an important perioperative goal. As the endocrine-metabolic responses to surgery are initiated primarily by neural stimuli travelling to spinal cord via somatic and sympathetic pathways, a segmental neural blockade of corresponding afferent pathways should be powerful enough to modify both, pain and stress response as well (1, 2).

However, although the safety and efficacy of regional anaesthesia are well documented, consensus on effects of acute postoperative pain control on outcomes is unfolding, and occasionally controversial (1, 3). A key point of this continuing controversy is the need for large patient numbers in any individual clinical trial due to the currently low incidence of major postoperative morbidity.

EPIDURAL ANALGESIA

The role of perioperative epidural anaesthesia and analgesia in reducing morbidity and mortality is controversial. Elderly studies, like the meta-analysis of 141 trials with nearly 10.000 patients have shown that perioperative neuraxial anaesthesia may reduce overall mortality by nearly 30%, the risk of deep venous thrombosis, pulmonary embolism, and pneumonia by 39–55 %, as well (4, 5). Unfortunately, many

study-designs related questions have been raised limiting the application of these results to a broader surgical population.

Recently, some of large randomized controlled trials have failed to show any major advantages of epidural technique (*6, 7*).

However, there is overwhelming evidence in the literature confirming the analgesic efficacy of epidural analgesia over parenteral opioids after major abdominal (*5, 6*) as well as after laparoscopic colorectal surgery (*8*). Furthermore, beneficial effects of postoperative epidural analgesia on reduction of GI paralysis are indisputable; presumably the block extent covers the dermatomes of surgical incision (*6*). An overall beneficial effect in terms of some measures of cardiac and pulmonary functions has also been found in elderly and high-risk patients (*5*).

More recently, in a retrospective study, multimodal analgesia regimen has been shown to be as effective as epidural analgesia regarding postoperative pain by reducing the incidence of major complications and side effects of epidural analgesia (*9*).

Novel techniques of postoperative regional analgesia, like transversus abdominis plane block and the re-introduction of paravertebral block, have been shown to be valuable alternatives to epidural analgesia after abdominal as well as after thoracic surgery (*10, 11*).

For many decades the risk of complications of epidural analgesia has been underestimated; the recent study has shown that the risk of severe neurological complications associated with epidural blocks in elderly patient is far higher than previously reported (*12*).

More recently, it was suggested that concerning a significant lack of evidence supporting postoperative epidural analgesia this method should not be routinely used in patients having abdominal surgery (*13*).

PERIPHERAL NERVE BLOCKS

Peripheral nerve blocks (PNB's) are analgesic modalities capable of providing excellent surgical anaesthesia, and by using catheter techniques easily converted into postoperative analgesia. Although not substantially different in terms of their possibility to block the nociception and abolish the stress response, PNB's have the advantage of being associated with less haemodynamic adverse effects, less postoperative nausea and vomiting and less potential for serious neurological complications when compared to neuraxial techniques.

The first description of a continuous peripheral nerve block (CPNB) is more than 60 years old (*14*). Subsequently, CPNB's have been described for almost every peripheral nerve or nerve plexus on upper as well as on lower extremity including axillary, interscalene, infraclavicular, paravertebral, psoas compartment, femoral, fascia iliaca as well as for proximal and distal sciatic nerve. The use of CPNB,s as an adjunct to pain control for orthopedic surgery of the upper and lower extremity as well has become increasingly commonplace (*15*).

The method involves the percutaneuous insertion of a catheter directly adjacent to the peripheral nerves. Local anesthetics, infused via catheter provide potent, site-specific analgesia with minor side effects. Unlike with epidural catheters, there is less concern regarding coagulation problems. Peripheral nerve catheters, preferably placed with the use of ultrasound may be used with newer anticoagulants. Peripheral nerve blocks produce a unilateral preganglionic sympathetic block causing only minimal, if any, cardio-vascular disturbances. Furthermore, perineural infusion does not require hospitalization, as do epidural infusion or intravenous opioids. Combining perineural catheters with portable infusion pumps, ambulatory patients may experience the same level of analgesia previously afforded only to the inpatients. These attributes, along with higher level of patient satisfaction make CPNB's an attractive and effective solution for postoperative pain management.

The first randomized, controlled, double blind trial providing evidence of infusion benefits after extensive shoulder surgery was not reported until 2000 (*15*). Subsequently, several other studies have demonstrated superior analgesia compared with intravenous opioids (*16–19*) in hospitalized as well as in ambulatory patients.

Dramatically lower opioid consumption in patients receiving perineural local anesthetics resulted in fewer opioid-related side effects, including a lower incidence of nausea, vomiting, pruritus, and sedation. Whether these demonstrated benefits result in an improvement in patient's health-related quality of life remains unexplored (*20*).

Because of existing inherent risks with a perineural catheters, this technique is frequently limited to patients expected to have at least moderate postoperative pain of a duration of at least 48h and not easily managed with oral opioids (*21, 22*) However, infusion may also be used following mildly painful procedures in order – to decrease or totally avoid the opioid consumption and opioid-related side effects (*23, 24*). Despite the lack of published data perineural infusion of local anesthetics may be particularly useful in elderly patients as a part of multimodal pain management as well as in pain management of addict patients.

Choice of local anaesthetics The majority of perineural infusion publications have involved low concentrated bupivacaine (0.15%) or ropivacaine (0,125%–0,2%), although levobupivacaine (*25*) and shorter acting agents have been reported (26). Unfortunately, the precise equipotent local anesthetic concentrations within the peripheral nervous system remain undetermined. Currently, there is insufficient information to determine if there is an optimal local anesthetic for ambulatory infusions.

Dosing regimen There are three basic approaches to LA delivery: continuous, intermittent bolus and continuous with intermittent bolus. The optimal LA dosing regimens for upper as well as for lower extremity blocks

may vary with anatomic location and choice of local anesthetic. Therefore, data from studies involving one catheter location and local anesthetic cannot necessarily be applied to another anatomic location. In general, providing continuous infusion with patient-controlled bolus gives the practitioner and the patient the greatest flexibility and is preferred method in the most institutions.

There are limited data available to base recommendations on the optimal basal rate, bolus volume, and lockout period (*27–29*). In all probability, confounding variables may affect the optimal regimen, including the surgical procedure, catheter location, physical therapy regimen, and specific local anesthetic infused. Most common recommended regimens use a basal rate of 5–10 ml/h, bolus volume of 3–5 ml and lockout time of 15–60 minute. Additionally, the maximum safe dose for the long-acting LA remains unknown. However, multiple investigations involving patients free of renal or hepatic disease have reported blood concentrations within acceptable limits following up to five days of perineural infusion with similar dosing schedules (*30–32*).

Complications Several prospective studies have shown low incidence of permanent damage caused by perineural catheter itself. Performance of interscalene block followed by catheter placement was associated with a very low incidence of permanent complications (*33*). However, interscalene perineural infusion will frequently cause paresis of the ipsilateral diaphragm but the effect on overall pulmonary function may be minimal in healthy patients (*34*). For continuous axillary catheters, the incidence of permanent neurological injury was found to be extremely low as well (*35*).

In general, the incidence of neurological complications related to both, peripheral blocks on upper and on lower extremity is very low. However, some minor transient neurological disturbances may be common (*35–38*).

Large prospective studies on inflammation and infection related to CPNB's have shown a rare incidence of complications (*38, 39*). The incidence was considerable increased with the duration of catheter placement, suggesting close observation of insertion site in patients with catheter for longer than three days.

PNB's and outcome In terms of effect on surgical outcome, improved quality of analgesia is the most common benefit measured in published studies. Regardless of catheter location, analgesia provided by continuous peripheral nerve blocks has been shown to be superior and with fewer opioid – related side effects when compared with opioid analgesia (40, 41) However, the debate concerning the short-term use of CPNB's on functional outcome after shoulder surgery is still open and somewhat controversial (*42, 43*).

CONCLUSION

The role of epidural analgesia in postoperative pain management is at present unclear. The use of CPNB's has grown dramatically in recent years. CPNB's have the potential to produce high quality analgesia with minimum morbidity compared to the other modalities of postoperative pain management. Outcome studies have analyzed the risks and shown the exceptional safety of CPNB's. Although already worldwide accepted as a part of the rehabilitation programs after major orthopedic surgery, there are still open questions and many areas for further expansion. Techniques of CPNB's should be included in all teaching programs and become a part of armamentarium of every practitioner involved in the perioperative management of orthopedic and/or trauma patient.

REFERENCES

1. TZIAVRANGOS E, SCHUG SA 2006 Regional anaesthesia and perioperative outcome. *Current Opinion in Anaesthesiology* 19: 521–525
2. Kehlet H, Holte K 2001 Effects of postoperative analgesia on surgical outcome. *Br J Anaesth* 87: 62–72
3. LIU S S,WU C L 2007 Effects of postoperative analgesia on major postoperative complications: a systematic update of the evidence. *Anesth Analg* 104: 689–702
4. RODGERS A, WALKER N, SHUG S et al 2002 Reduction of postoperative mortality and morbidity with epidural and spinal anaesthesia: Results from overview of randomized trials. *Br Med J 321:* 1493–1496
5. RIGG J, YAMROZIK K, MYLES P et al. 2002 Epidural anaesthesia and analgesia and outcome of major surgery: a randomized trial. *Lancet 359*: 1276–1282
6. MARRET E, REMY C, BONET F 2007 Meta-analysis of epidural analgesia vs. parenteral opioid analgesia after colorectal surgery. Br J *Surg 94*: 655–73
7. RATMELL J P, WU C L, SINATRA R S et al 2006 Acute post--surgical pain management: A critical appraisal of current practice. *Reg Anesth Pain Med* 31: 1–42
8. TURUNEN P, CARPELAN-HOLSTRÖM M, KAIROLUMA P et al 2009 Epidural analgesia diminished pain but did not otherwise improve enhanced recovery after laparoscopic sigmoidectomy: a prospective randomized study. *Surg Endosc 23*: 31–37
9. CHILVERS C R, NGUYEN M H, ROBERTSON I K 2007 Changing from epidural to multimodal analgesia for colorectal laparotomy: an audit. *Anaesth Intensive Care 35*: 230–38
10. MCDONELL J G, O'DONNELL B, HEFFERNAN A et al 2007 The analgesic efficacy of transversus abdominis plane block after abdominal surgery: a prospective randomized controlled trial. *Anesth Analg 104*: 193–97
11. DAVIES R G, MYLES P S, GRAHAM J M 2006 A comparison of the analgesic efficacy and side-effects of paravertebral vs. epidural blockade for thoracotomy – a systematic review and meta-analysis of randomized trials. *Br J Anaesth 96*: 418–26
12. MOEN V, DAHLGREN N, IRESTEDT L 2004 Severe neurological complications after central neuraxial blockades in Sweden 1990–19999. *Anesthesiology 101*: 990–9
13. LOW J et al 2008 Epidural analgesia: first do no harm. Anaesthesia 63: 1–3 (editorial).
14. ANSBRO FP 1946 A method of continuous brachial plexus block. *Am J Surg 71*: 716–22.
15. ILFELD B M, MOREY T E, ENNEKING F K 2002 Continuous infraclavicular brachial plexus block for postoperative pain control at home: a randomized, double-blinded, placebo-controlled study. *Anesthesiology 96*: 1297–304
16. BORGEAT A, TEWES E, BIASCA N et al 1998 Patient-controlled interscalene analgesia with ropivacaine after major shoulder surgery: PCIA vs PCA. *Br J Anaesth 81*: 603–5
17. BORGEAT A, SCHAPPI B, BIASCA N et al 1997 Patient-controlled analgesia after major shoulder surgery: patient-controlled interscalene analgesia versus patient-controlled analgesia. *Anesthesiology 87*: 1343–7

18. ILFELD B M, WRIGHT T W, ENNEKING F K *et al* 2003 Continuous interscalene brachial plexus block for postoperative pain control at home: a randomized, double-blinded, placebo-controlled study. *Anesth Analg 96*: 1089
19. BORGEAT A, EKATODRAMIS G, DUMONT C 2001 An evaluation of the infraclavicular block via a modified approach of the Raj technique. *Anesth Analg 93*: 436–41
20. WU C L, NAQUBUDDIN M, ROWLINGSON J A *et al* 2003 The effect of pain on health-related quality of life in the immediate postoperative period. *Anesth Analg 97*: 1078–85
21. EKATODRAMIS G, MACAIRE P, BORGEAT A 2001 Prolonged Horner syndrome due to neck haematoma after continuous interscalene block. *Anesthesiology 95*: 801–3
22. RIBEIRO F C, GEORGOUSIS H, BERTRAM R *et al* 1996 Plexus irritation caused by interscalene brachial plexus catheter for shoulder surgery. *Anesth Analg 82*: 870–2
23. RAWAL N, AXELSSON K, HYLANDER J *et al* 1998 Postoperative patient-controlled local anesthetic administration at home. *Anesth Analg 86*: 86–9
24. RAWAL N, ALIVIN R, AXELSSON K *et al* 2002 Patient-controlled regional analgesia (PCRA) at home: controlled comparison between bupivacaine and ropivacaine brachial plexus analgesia. *Anesthesiology 96*: 1290–6
25. CASATI A, BORGHI B, FANELLI G *et al*. 2003 Interscalene brachial plexus anaesthesia and analgesia for open shoulder surgery: a randomized, double-blinded comparison between levobupivacaine and ropivacaine. *Anesth Analg 96*: 253–9
26. BÜTTNER J, KLOSE R, HOPPE U *et al* 1989 Serum levels of mepivacaine-HCI during continuous axillary brachial plexus block. *Reg Anesth 14*: 124–7
27. ILFLED B M, MORY T E, WRIGHT T W *et al* 2003 Interscalene perineural ropivacaine infusion: a comparison of two dosing regimens for postoperative analgesia. *Reg Anesth Pain Med 29*: 290–6
28. SINGELYN F J, SEGUY S, GOUVERNEUR M J 1999 Interscalene brachial plexus analgesia after open shoulder surgery: continuous versus patient-controlled infusion. *Anesth Analg 89*: 1216–20
29. ISKANDAR, RAKOTONDRIAMIHARY, DIXMERIAS *et al*. 1998 Analgesia using continuous axillary block after surgery of severe hand injuries: self-administrations vs continuous injection. *Ann Fr Anesth Reanim 17*: 1099
30. EKATODRAMIS G, BORGEAT A, HULEDAL G *et al* 2003 Continuous interscalene analgesia with ropivacaine 2mg/ml after major shoulder surgery. Anesthesiology 98: 143–50
31. KALOUL, GUAY, COTE *et al* 2004 Ropivacaine plasma concentrations are similar during continuous lumbar plexus blockade using the anterior three-in-one and the posterior psoas compartment technique. *Can J Anesth 34*: 468–72
32. MEZZATESTA J P, SCOTT D A, SCHWEITZER S A *et al* 1997 Continuous axillary brachial plexus block for postoperative pain relief. Intermittent bolus versus continuous infusion. *Reg Anesth 22*: 357–62
33. BORGEAT A, EKATODRAMIS G, KALBERER F *et al* 2001 Acute and non-acute complications associated with interscalene block and shoulder surgery. *Anesthesiology 95*: 875–80
34. BORGEAT A, PERSCHAK H, BIRD P *et al* 2000 Patient-controlled interscalene analgesia with ropivacaine 0,2% versus patient--controlled intravenous analgesia after major shoulder surgery: Effects on diaphragmatic and respiratory function. *Anesthesiology 92*: 102–8
35. BORGEAT A, KALBERER, JACOB *et al* 2001 Patient-controlled interscalene analgesia with ropivacaine 02% versus bupivacaine 0,15% after major open shoulder surgery: the effects on hand motor function. *Anesth Analg 92*: 218–23
36. WIEGEL M, GOTTSCHALDT U, HENNEBACH R *et al* 2007 Complications and adverse effects associated with continuous peripheral nerve blocks in orthopedic patients. *Anesth Analg 104*: 1578–82
37. BERGMANN B D, HEBL JR, KENT J, HORLOCKER T T 2003 Neurologic complications of 400 consecutive continuous axillary catheters. *Anesth Analg 96*: 247–52
38. CAPDEVILA X, PIRAT P, BRINGUIER S *et al* 2005 Continuous peripheral nerve blocks in hospital wards after orthopaedic surgery. A multicenter prospective analysis of the quality of postoperative analgesia and complications in 1416 patients. *Anesthesiology 103*: 1035–45
39. NEUBURGER M, BÜTTNER J, BLUMENTHAL S *et al* 2008 Inflammation and infections of 2285 perineural catheters: a prospective study. Acta Anaesthesiol *Scand 51*: 108–114
40. RICHMANN J M, LIU S S, COURPAS G *et al* 2006 Does continuous peripheral nerve block provide superior pain control to opioids? A meta-analysis. *Anesth Analg 102*: 248–57
41. MACFARLANE A J R, GOVINDARAJULU A P, CHAN V 2009 Does regional anesthesia improve outcome after total knee arthroplasty? *Clin Orthop Relat Res 46*: 2379–2402
42. ILEFELD B M,WRIGHT T W, ENNEKING F K, MOREY T E 2005 Joint range of motion after total shoulder arthroplasty with and without a continuous interscalene block: a retrospective, case control study. *Reg Anesth Pain Med 30*: 429–433
43. HOFFMANN-KIEFER K, EISER T, CHAPPELL D *et al* 2008 Does patient-controlled interscalene block improve early functional rehabilitation after open shoulder surgery? *Anesth Analg 106*: 991–996