Role of regional anaesthesia in postoperative pain management

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 catheters 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 percutaneous 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, preferable 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 in-patients. 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 anesthetics. 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.

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