The Use of Stimulating Catheter for Continuous Brachial Plexus Block Advantages and Safety

Essay submitted for the partial fulfillment of the master degree in anesthesiology

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LIST OF ABBREVIATIONS

- ATPase: Adenosine triphosphatase.
- C : Cervical.
- cm: Centimeter.
- CPNB: Continuous peripheral nerve block.
- CT: Computerized tomography.
- ECG: Electrocardiogram.
- h: Hour.
- Hz: Hertz.
- IV PCA: Intravenous patient controlled analgesia.
- K+: Potassium ions.
- Kg: Kilogram.
- Lat.: Lateral.
- m.A: Mill ampere.
- Med.: Medial.
- mEq: Mill equivalent.
- mg: Milligram.
- ml.: Milliliter.
- mm.: Millimeter.
- m.s: Millisecond.
- Na+: Sodium ions.
- PCRA: patient-controlled regional analgesia.
- pKa: Dissociation coefficient.
- PNS: Peripheral nerve stimulator.

- SCM: Sternocleidomastoid.
- T : Thoracic.
- vs.: Versus.
- µs: Microsecond.
- µg: Microgram.
- ° : Degree.

Abstract:

Many approaches but only two techniques for continuous brachial plexus block stimulating-catheter, or non stimulating-catheter technique. The stimulating catheter is more difficult and time consuming but has much more advantages: reduces secondary block failure, avoids catheter migration or misplacement, reduces requirements of local anesthetics, and less incidence of catheter coiling.

Keywords:

Continuous brachial plexus block - Stimulating catheters – peripheral nerve block.

Introduction

Introduction:

Continuous plexus and peripheral nerve blocks (CPNB) offer the potential benefits of prolonged analgesia with fewer side effects, greater patient satisfaction, and faster functional recovery after surgery. Peripheral nerve localization using electrical stimulation via insulated needles has become a widespread practice in regional anesthesia. The use of continuous peripheral nerve catheters inserted through these same needles is a relatively new technique, used to provide an extended period of analgesia after surgery. There is continuing debate as to whether the use of the same electrical stimulation that aids in localizing specific nerves is also beneficial for optimizing placement of nerve catheters and will lead to measurable improvements in clinical outcomes [1,2,3].

There is evidence for superior analgesia and a less frequent incidence of opioid-related side effects of continuous perineural infusions compared with intravenous patient controlled anesthesia (IV PCA) for open shoulder procedures and upper arm surgery, but there are insufficient data to provide firm recommendations for virtually all aspects of continuous plexus analgesia. The use of continuous interscalene analgesia reduced opioid requirements compared with placebo [4,5,6] Compared with IV PCA for open shoulder surgery, prospective, randomized, controlled trials further demonstrated that the use of continuous interscalene analgesia not only reduced requirements for postoperative opioids [7], but also provided better analgesia, reduced opioid-related side effects, and provided better patient satisfaction for at least the first 48 h after surgery. In contrast to documented benefits of continuous interscalene analgesia, definitive benefits from continuous axillary brachial plexus block have not been established. Case series reported satisfactory analgesia after hand and forearm procedures with continuous axillary brachial plexus infusions (0.2%–0.25%

bupivacaine or 0.5% mepivacaine) but have not compared these regimens with IV PCA or other methods of systemic analgesia [8,9].

Long-acting local anesthetics are being investigated for peripheral nerve blocks of 2–7 days' duration [10,11], and commercial introduction of such preparations may in the future obviate continuous catheter techniques .

Aim:

Emphasizing that continuous brachial plexus block is a safe and reliable solution for most orthopedic procedures, as regard intra-operative reliability, post-operative course and analgesia.

Chapter 1

Historical Overview

Early recorded uses of electrical nerve stimulation include assisting in accurate placement of a catheter for neuraxial blockade in 1948,[12] followed shortly thereafter by catheter placement for continuous peripheral nerve blockade in 1950.[13]

Anatomical landmarks were still used at that time to place the needle through which the catheter was advanced. Stanley Sarnoff, M.D. (1917–1990) and his wife Lili-Charlotte Sarnoff, R.N., almost accidentally pioneered the use of nerve stimulation for the accurate placement of catheters for continuous peripheral perineural and subarachnoid blockade while working at the Harvard University School of Public Health (Boston, Massachusetts).In the midst of the polio epidemic of the 1950s, they developed the "Electrophrenic Respirator" for artificial ventilation of patients with bulbar polio by percutaneous phrenic nerve stimulation.[14]

This device later served as a "nerve stimulator" to place a continuous nerve block catheter on the phrenic nerve for a patient with intractable hiccups.[13] Although later workers were not aware of the previous use of "stimulating catheters" in 1950, years later, in 1999, after the use of nerve stimulators for single-injection blocks of peripheral nerves had been well established, they reinvented the technique of placing catheters for CPNBs by stimulating the nerve via both the needle and the catheter.[15]

In the 30 yr after the first descriptions, the main focus in the development of CPNBs was on the upper extremity, and it was mainly to improve blood flow by sympathetic blockade for re-implantations of traumatic upper limb amputations. Most authors used variations of the axillary perivascular technique in the 1970s and 1980s.[16] At the time, the analgesia was almost viewed as an additional bonus, because it was not the primary purpose of the block.

During the 1990s, the emphasis shifted toward the use of CPNBs to manage acute postoperative pain. This was, among other factors, driven by the quest for cost-effective ambulatory surgery after the exponential explosion of medical inflation in the mid to late 1980s.Salter's discovery of the beneficial use of continuous passive motion for rehabilitation also played an important role in this development.(17)

Because of the efficiency and relative safety of continuous neuraxial nerve blocks, the lower extremity received little attention during the early development of continuous nerve blockade; the main focus was on continuous interscalene blocks.(18,19)

Singelyn et al.,(20) who worked in Belgium, addressed the question of whether CPNB made any difference to the outcomes of surgery. They demonstrated that continuous femoral nerve blockade for a total knee replacement operation was superior to patient-controlled intravenous morphine in managing postoperative pain for total knee arthroplasty, with earlier and better rehabilitation.

They also demonstrated fewer side effects than epidural analgesia, although the analgesia was similar. These results were confirmed in France (21) and the United States.(22)

A frustrating problem with perineural catheters was inaccurate catheter placement and secondary block failure, which defeated the object of cost effectiveness. The stimulating catheter originated from this frustration in 1999.(15)