CASE STUDY

A Cost Benefit Analysis - Bilateral Infraclavicular Nerve Block: Single Injection Liposomal Bupivacaine Vs Bupivacaine HCl with Epinephrine and Dexamethasone

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Keywords: CDC, opioid therapy, PNBC, SINB

1 | INTRODUCTION:

According to the CDC there were roughly 671,000 fracture reductions performed on inpatients in 2010. (1) Regional anesthesia has been paramount in diminishing a reliance on opioid therapy for these patients that present with acute pain. Peripheral nerve blocks became increasingly interesting for its potential anti-inflammatory benefits (2) and early mobilization after surgery (2, 3). Procedures such as peripheral nerve blocks, in the form of single injection nerve blocks (SINB) or insertion of peripheral nerve block catheters (PNBC), have become an integral part of a multimodal approach to postoperative pain management (4). The decision making process behind insertion of peripheral nerve block catheter or single injection nerve block can be multifactorial, however the main determining factor is often the desired duration of nerve block.

For decades PNBC have been the preferred modality in extending the duration of peripheral nerve blocks past the duration offered by SINB. It became a worldwide trend to use PNBC in an ambulatory setting (2). By allowing a means to deliver a continued infusion of local anesthetic to the area of interest, often bupivacaine alone or bupivacaine mixed with an opioid, PNBC have been able to offer patients a reasonable period of analgesia postoperatively, decreasing opioid consumption (2). Like SINB, PNBC are accompanied by relative contraindications influenced by patient comorbidities. These comorbidities include coagulopathy, infection, preexisting neural damage, a perceived risk of masking compartment syndrome or a need to closely monitor neuromuscular function postoperatively (5). Also, akin to both are certain risks associated with performing the nerve block itself such as nerve damage, bleeding, local anesthetic toxicity, infection or block failure. Nonetheless, these procedures have shown proven benefit in regards to pain control that outweighs these risks as well as potential cost savings over intravenous opioid therapy alone or intra-articular injection (3).

With the recent advent of new local anesthetic compounds, namely liposomal bupivacaine, the length of...
nerve block duration previously achieved with SINB can theoretically be increased to durations comparable to those achieved safely with PNBC. It was not until 2018 that FDA approved the use of liposomal bupivacaine in regional anesthesia; it was originally approved for use of local infiltration of surgical wounds for postoperative analgesia (4, 6). The use of liposomal bupivacaine for peripheral nerve blocks is intentionally for increase block duration without the use of invasive nerve block catheters. These catheters are also limited by pump failure, catheter dislodgement and susceptibility for infection (4). On the other hand, benefits from use of liposomal bupivacaine, aside from increasing block duration, includes block efficacy, patient comfort and overall cost benefit (7). It was also found to have less risk for LAST due to encapsulated bupivacaine multivesicular liposomal properties.

We present a patient with a unique opportunity to compare standard approach to postoperative pain management with PNBC against SINB with liposomal bupivacaine for extended nerve block analgesia. This case offered an opportunity for our patient to act as his own control and by doing so allowing analysis of two approaches to postoperative analgesia. In theory, the use of liposomal bupivacaine for SINB would extend the duration of nerve block to the extent that a PNBC would not be necessary. Our goal was to quantify the duration of time which liposomal bupivacaine would extend our nerve block past that of prior used medications by assessing patient comfort. Furthermore, we also ask if there is any benefit of performing SINB with liposomal bupivacaine in lieu of PNBC from a cost-benefit viewpoint?

2 | CASE REPORT:

A 47-year-old male with no significant past medical history arrived via ambulance after a motorcycle accident resulting in multiple fractures through the midshaft of the left radius and ulna and an open fracture of the right distal radius and ulna. The evening of arrival he would undergo irrigation and debridement with external fixation of his right-sided fracture. The following morning the patient would be consented for postoperative brachial plexus nerve block with or without catheter placement of his bilateral upper extremities. He then would return to the operating room for definitive fixation of both his right and left upper extremities. After roughly a 6-hour operation with no complications he arrived to the post anesthesia care unit and was prepared for bilateral infraclavicular nerve blocks.

3 | METHOD:

The decision was made to perform the left-sided infraclavicular nerve block with readily available medications that would maximize the duration of nerve block, bupivacaine 0.25% with epinephrine 1:200,000 mixed with dexamethasone 8mg. A PNBC would also be placed and would infuse normal saline during the time period we evaluated the duration of adequate nerve block, in the event the patient complained of considerable pain of his left upper extremity we would then bolus the catheter with local anesthetic and commence a bupivacaine/fentanyl infusion. The right-sided infraclavicular nerve block would be performed with 20 milliliters of liposomal bupivacaine 1.3% and as well have placed a PNBC that would infuse normal saline during the time period we evaluated the duration of adequate nerve block. In the event the patient complained of considerable pain of either of his upper extremities, which would not respond to administration of minimal intravenous rescue medication, we would then bolus the catheter with local anesthetic and commence a bupivacaine/fentanyl infusion. The commencement of fentanyl/bupivacaine infusion represented our endpoint of adequate nerve block analgesia for each respective nerve block.

After a short time in the post anesthesia care unit with the patient adequately awake, the left sided infraclavicular nerve block was performed under sterile conditions, with ultrasound guidance and nerve stimulating needle. Capture of motor response was elicited at 0.48 milliamps and relevant anatomy of the axillary vessels and cords of the brachial plexus deep to the pectoralis muscles were visualized. Appropriate spread of local anesthetic was placed around the axillary artery, dissecting the cords away from the artery, a total of 30 milliliters of bupivacaine 0.25%
with epinephrine 1:200,000 mixed with 8 milligrams dexamethasone solution. Following anesthetic infiltration, a catheter was tunneled under the brachial plexus and secured in place with adhesive bandaging. The PNBC was then attached to our portable infusion pump and allowed to infuse 0.9% normal saline at 2 milliliter per hour.

Following placement of the left sided catheter, we then prepared and draped the right upper extremity for placement of the right-sided infraclavicular nerve block and catheter. Again, with ultrasound guidance and nerve stimulating needle capture of motor response was elicited at 0.44 milliamps and relevant anatomy of the axillary vessels and cords of the brachial plexus deep to the pectoralis muscles were visualized. Liposomal bupivicaine 1.3% was deposited around the axillary artery, dissecting the cords away from the artery for a total volume of 20 milliliters. Again, a catheter was tunneled under the brachial plexus and secured in place with adhesive bandaging. The PNBC was then attached to our portable infusion pump and allowed to infuse 0.9% normal saline at 2 milliliter per hour.

After each block the patient adequate relief of pain was verified, patient had minimal to no motor blockade. Pain level would be monitored by his spouse on a numeric rating scale 0-10 with intravenous rescue medication available for moderate pain. In the event our patient experienced severe pain or pain unresponsive to rescue medication in a specific limb the PNBC would then be bolused with 10 milliliters of 2% lidocaine and a fentanyl 2 microgram per milliliter/bupivicaine 0.125% solution would then be infused to supply continued analgesia to the limb of interest.

4 | DISCUSSION:

The recent advent of liposomal bupivicaine has added a great tool in the realm of postoperative pain management. It’s long duration of action compared to its parent compound, regular bupivicaine, is secondary to its unique structure. Liposomal bupivicaine exists as a suspension of multivesicular liposomes, which allows for slow, steady release of bupivicaine from gradual breakdown of these vesicles (3, 8, 9). This unique aspect of pharmokinetics results in two peaks of intravenous absorption of bupivicaine. One peak occurs after absorption of free bupivicaine in the liposomal suspension and a second due to slow, continued release via multivesicular liposomes (3, 4, 9). The Food and Drug Administration has approved it for local infiltration of surgical wounds and for peripheral nerve blocks and regional anesthesia. Multiple case reports and randomized control studies have examined its use in such a setting and have showed good results as well as most importantly no notable ill side effects or reactions (4, 8, 10). In our specific patient we were able to report the same, however we also wished to scrutinize if any real benefit over more commonly performed PNBC placement existed, both clinically as well as in cost benefit.

By inquiring our pharmacy we were able to calculate the cost of performing a peripheral nerve block with what could be considered commonly used, readily available medications. In this case 30 milliliters of bupivicaine 0.25% with epinephrine 1:200,000 mixed with dexamethasone 8mg was used to achieve adequate immediate postoperative analgesia, totaling a cost of $7.19. To extend the duration of peripheral nerve block in this setting, especially in the case of a patient who is post trauma and requires continued in-hospital care, a PNBC attached to continuous fentanyl/bupivicaine infusion, $19.07, was added to give the patient continue adequate comfort.

This regimen can be compared to SINB with 20 milliliters of liposomal bupivicaine, a total cost of $300. It was evident that our patient did achieve a longer duration nerve block with liposomal bupivicaine, a few hours, however from a cost benefit standpoint it may not justify its greater cost of use.
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in this inpatient setting. Of note, the patent for liposomal bupivacaine, Exparel, will shortly expire in 2021, so cost analysis with generic formulation over PNBC would require to be reassess. It is important to keep in mind however that if placement of PNBC risks, such as infection, bleeding secondary to coagulopathy or anticoagulant use, are outweighed by benefits of SINB, liposomal bupivicaine can act as an ideal agent to extend the duration of nerve block. By doing so, this may possibly lead to more speedy recovery and hospital discharge, thus saving money. Further studies and research are necessary to prove this.

5 CONCLUSION:

Whichever modality and agents used, it is without question that analgesia and opioid sparing effects achieved by regional anesthesia and pain management are of great benefit to the patient. Thus, decreasing overall health care cost by improving postoperative outcome, such as earlier ambulation, earlier discharge and earlier physical therapy achievements. Taking advantage of enhanced pharmokinetics of new anesthetic agents, postoperative pain control can be further tailored to maximize patient comfort and health care savings. As the scope of use of liposomal bupivacaine continues to widen perhaps its cost of use will decrease, especially after formulary patent expires, possibly by 2021.

As these newer agents, in this case liposomal bupivicaine, scope of uses continues to widen perhaps its cost of use will decrease. With each clinical scenario and its unique circumstances there exists appropriate medications and interventions and liposomal bupivicaine deserves to be in the discussion of options. Just as deserving are readily available, inexpensive, proven effective medications and interventions as well.

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How to cite this article: Charlota J., Ferdinand I., Daniel E.J. A Cost Benefit Analysis - Bilateral Infraclavicular Nerve Block: Single Injection Liposomal Bupivacaine Vs Bupivacaine HCl with Epinephrine and Dexamethasone. International Journal of Contemporary Research,. 2020;20789–20793. https://doi.org/10.15520/ijcrr.v11i06.815