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Case Report

Bilateral Brachial Plexus Blocks for Bilateral Upper Extremity Surgery

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Abstract

Bilateral brachial plexus blocks for bilateral upper extremity surgery carry significant risks which may dissuade practitioners from offering them to patients. Here we report a case series of successful and uneventful bilateral brachial plexus blocks performed at our institution and offer a discussion of strategies to guide management. We contend that slight modifications in block technique, local anesthetic administration, and patient selection can make bilateral brachial plexus blocks safe and effective for routine use.

Introduction

Bilateral peripheral nerve blocks for bilateral extremity surgery are rarely performed in modern anesthesia practice for various reasons. Performing bilateral blocks can be time consuming and delay commencement of surgery. Bilateral blocks are likely to increase patient discomfort when performed preoperatively in awake patients. Practitioners may also be hesitant to administer higher total doses of local anesthetics for fear of increased risk of Local Anesthetic Systemic Toxicity (LAST), and using smaller doses on each side may be perceived as reducing block effectiveness and duration. Upper extremity blocks also carry serious risks of pneumothorax, phrenic nerve palsy with diaphragmatic hemiparesis, and neuraxial injection, all of which can be catastrophic if incurred bilaterally [1-4].

Here we describe a case series report of 5 cases of successful bilateral peripheral nerve blockade for bilateral distal radius fracture Open Reduction Internal Fixation (ORIF), done over a 4 year period at our institution. We contend that bilateral brachial plexus blocks can be done safely and routinely, provided they are performed in distal locations, under conscientious ultrasound guidance, and with nerve stimulation monitoring. We also postulate that the higher total doses of local anesthetic needed to achieve satisfactory and durable blockade are indeed safe as long as they are administered in specific ways and in patients who meet certain clinical criteria.

Case Description

Case 1

64 year old female, 82 kg, presented for ORIF of bilateral distal radius fractures sustained after a mechanical fall. Past medical history included a history of embolic stroke 10 years earlier with no residual deficit. An echocardiogram from 6 years prior demonstrated normal ventricular function with a possible right to left interatrial shunt. Because of this, she was chronically managed on warfarin which was stopped 5 days prior to surgery. Renal function labs were normal.

The patient was monitored and given IV midazolam and fentanyl for sedation. Left, then right, axillary blocks were performed sequentially under ultrasound guidance using a 22 g Problock insulated stimulating needle. Nerve stimulation was used to identify median, ulnar, radial, and musculocutaneous nerve responses with no motor responses at a current of 0.5 mA. A total of 60cc 0.5% ropivacaine was given (3.66 mg/kg). Time elapsed between the left and right injections were estimated between 10-15 minutes. After the blocks were complete and deemed satisfactory, the patient was brought to the OR and was sedated with a propofol infusion and low dose ketamine boluses. Left and right distal radius ORIFs were performed simultaneously by two separate surgical teams with pneumatic tourniquets on each upper arm. The patient was brought to recovery in satisfactory condition. No narcotic or pain medication was requested or administered in recovery room. Patient was discharged home under the care of a responsible adult with appropriate care and return instructions.

Case 2

29 year old male, 65 kg, presented for ORIF of bilateral distal radius fractures sustained after a mechanical fall. Past medical history included a history of polysubstance abuse, including

methamphetamine, cocaine, and heroin. Urine toxicology screen was negative on the day of surgery.

The patient was monitored and given IV midazolam and fentanyl for sedation. Left, then right, axillary blocks were performed sequentially under ultrasound guidance using a 22 g Problock insulated stimulating needle. Nerve stimulation was used to identify median, ulnar, radial, and musculocutaneous nerve responses with no motor responses at a current of 0.5 mA. A total of 80cc 0.5% ropivacaine was given (6.15 mg/kg). Time elapsed between the left and right injections were estimated between 10-15 minutes. After the blocks were complete and deemed satisfactory, the patient was taken to the OR where general anesthesia was induced with propofol 200 mg IV and the airway secured with a #4 LMA. Anesthesia was maintained with Sevoflurane. Right, then left, distal radius fracture ORIFs was performed sequentially by one surgical team with pneumatic tourniquets on the upper arm. Emergence and LMA removal were uneventful. No narcotic or pain medication was requested or administered in the recovery room. Patient was discharged home under the care of a responsible adult with appropriate care and return instructions.

Case 3

23 year old male, 67 kg, presented for ORIF of bilateral distal radius fractures, sustained after a fall off a motorcycle. Past medical history was unremarkable.

The patient was monitored and given IV midazolam and fentanyl for sedation. Right, then left, axillary blocks were performed sequentially under ultrasound guidance using a 22 g problock insulated stimulating needle. Nerve stimulation was used to identify median, ulnar, radial, and musculocutaneous nerve responses with no motor responses at a current of 0.5 mA. A total of 50cc 0.5% ropivacaine was given (3.73 mg/kg). Time elapsed between the left and right injections were estimated between 10-15 minutes. After the blocks were complete and deemed satisfactory, the patient was taken to the OR where general anesthesia induced with propofol 200 mg and rocuronium 50 mg, and the airway secured with a 7.0 endotracheal tube. Anesthesia was maintained with Sevoflurane. Right, then left, distal radius fracture ORIFs was performed sequentially by one surgical team with pneumatic tourniquets on the upper arm. Emergence and extubation were uneventful. No narcotic or pain medication was requested or administered in the recovery room. Patient was discharged home under the care of a responsible adult with appropriate care and return instructions.

Case 4

48 year old male, 88 kg, presented for ORIF of bilateral distal radius fractures sustained after a mechanical fall. Past medical history was only remarkable for gastro esophageal reflux disease.

The patient was monitored and given IV midazolam and fentanyl for sedation. Left, then right, axillary blocks were performed sequentially under ultrasound guidance using a 22 g Problock insulated stimulating needle. Nerve stimulation was used to identify median, ulnar, radial, and musculocutaneous nerve responses with no motor responses at a current of 0.5 mA. A total of 60cc 0.5% ropivacaine was given (3.41 mg/kg). Time elapsed between the left and right injections were estimated between 10-15 minutes. After blocks were complete and deemed satisfactory, the patient was brought to the OR and given IV sedation with a low dose propofol infusion. After examination under anesthesia with manipulation and fluoroscopic evaluation, the right distal radius fracture was deemed non-operative. The left distal radius ORIF was then performed with a pneumatic tourniquet on the upper arm. Patient was brought to recovery in satisfactory condition. No narcotic or pain medication was requested or administered in the recovery room. Patient was discharged home under the care of a responsible adult with appropriate care and return instructions.

Case 5

63 year old female, 70 kg, presented for ORIF of bilateral distal radius fractures sustained after a mechanical fall. Past medical history included diabetes, hypertension, and a history of meningioma requiring craniotomy, followed by re-resection and radiation for recurrence. Echocardiogram and dobutamine stress test were normal one year earlier. Labs for renal and liver function were normal.

The patient was monitored and given IV midazolam and fentanyl for sedation. Left axillary and Right elbow block were performed sequentially under ultrasound guidance using a 22 g Problock insulated stimulating needle. Nerve stimulation was used to identify median, ulnar, radial, and musculocutaneous nerve responses with no motor responses at a current of 0.5 mA. A total of 60cc 0.5% ropivacaine was given (4.29 mg/kg). Time elapsed between the left and right injections were estimated between 10-15 minutes. After block complete and deemed satisfactory, general anesthesia induced with propofol 100 mg and fentanyl 100 mcg and airway secured with a #4 LMA. Anesthesia was maintained with Sevoflurane. Left and right distal radius ORIF was performed simultaneously by two separate surgical teams with pneumatic tourniquet on upper arm. Emergence and LMA removal were uneventful. No narcotic or pain medication was requested or administered in recovery room. Patient was discharged home under the care of responsible adult with appropriate care and return instructions.

Discussion

Bilateral brachial plexus blocks may carry increased risks which can dissuade practitioners from offering them to patients undergoing bilateral upper extremity surgery. In this small case series, we found bilateral upper extremity blocks to be safe and effective for bilateral ORIF cases, with the added advantage of reducing postoperative narcotic requirement. No complications were encountered in any of our five cases, and all patients had an expedited discharge after the procedure. Given our favorable outcomes, we offer the following discussion of strategies for management.

Block location

Despite safety and efficacy concerns, there are numerous reports in the literature of successful bilateral blocks. Mejia-Terrazas et al. described a case series of 4 uncomplicated bilateral upper extremity blocks in the interscalene, supraclavicular and infraclavicular positions, and also collated a number of case reports from the literature of successful, uncomplicated upper extremity blocks at various positions both distal and proximal. These authors correctly noted that these data are drawn from isolated case reports and controlled studies of bilateral blocks are unlikely to be forthcoming, especially given the widely accepted respiratory side effects of more

proximal blocks such as the interscalene and supraclavicular block. They contend that bilateral blocks in any upper extremity location are acceptable provided the clinical risk/benefit analysis favors their use over any other technique [3].

Our institution's practice and experience leads us to believe that more distal locations are always favorable when performing bilateral upper extremity blocks. Most authors quote the rate of phrenic nerve and diaphragmatic involvement as high as 100% and 50% for blocks in the interscalene and supraclavicular positions [5], rates which we consider unacceptably high no matter the patient's underlying respiratory reserve. Ultrasound guidance may reduce this risk, but is unlikely to completely eliminate these risks [6]. There is also compelling evidence that local anesthetic levels peak more quickly in blocks above the clavicle than those below [7]. We therefore choose not to perform bilateral blocks above the clavicle. Consideration should only be given to performing one of the blocks above the clavicle, however, provided the other is below and the patient has adequate pulmonary reserve.

Block technique

Ultrasound guidance for peripheral nerve blockade is currently standard of care and offers obvious benefits. Ultrasound guidance reduces the incidence of LAST when compared to non-ultrasound techniques [8]. When compared to nerve stimulation alone, ultrasound guidance improves the efficacy of nerve blockade [9] and can reduce the volume of local anesthetic needed for effective block [10-12].

Fewer studies have attempted to ascertain the utility of combining ultrasound guidance with nerve stimulation. Some have claimed little efficacy benefit with using nerve stimulation as an adjunct to ultrasound guidance [13], while others have shown that a combined technique can increase success rate for certain blocks [14]. Still others have advocated for a combined technique, using ultrasound to guide needle trajectory/depth, and nerve stimulation delivered at a constant low intensity current to detect intra neural needle placement. Nerve stimulation monitoring in this way provides high specificity for intra neural needle placement and may offer additional protection against nerve injury [15,16]. We contend that because peripheral nerves are being blocked in two separate anatomic locations and with larger total volumes of local than would ordinarily be used, bilateral peripheral nerve blocks may carry an increased cumulative risk of nerve injury and LAST, when compared to unilateral blocks. A combined ultrasound and nerve stimulation technique may be the best way to mitigate both these risks.

Temporal spacing between blocks

Some authors have advocated for extended time spacing between blocks, as a means to detect evolving signs of LAST from the first block, and to ensure that peak absorption does not occur simultaneously [3,4]. While this is certainly a prudent suggestion, we also acknowledge that LAST can develop in unpredictable temporal sequences following blocks, sometimes occurring over an hour after the actual injection [17,18]. No specific recommendations, therefore, can be made on an adequate amount of time that should elapse between blocks. It seems most prudent therefore to allow for as much time as reasonably possible given what operative circumstances and time constraints dictate.

Local anesthetic dose, agent, and additives

Although recommendations exist for the range of acceptable local anesthetic doses for infiltration, maximum allowable doses are more difficult to delineate. Some authors have suggested that no precise numerical value can be designated for maximal dose recommendations, given wide variability in both individual patient characteristics and effect/systemic absorption at different block locations [19]. Indeed, two studies utilizing a total of 164 patients document uncomplicated ropivacaine administration for axillary block in dosages greater than or equal to 300mg per patient, and/or in excess of the commonly quoted maximum dose of 3 mg/kg [20,21]. These studies were also done with nerve stimulation alone and without the local-anesthetic sparing benefit of ultrasound guidance. One small case study even demonstrated sub-toxic plasma ropivacaine levels after 450 mg or ropivacaine was given in combined femoral/sciatic block [22]. Granted, there is numerous case reports of CNS toxicity at these higher levels, but these should not keep us from offering higher doses if the clinical benefit outweighs the risk.

Long acting amide stereoisomer's such as ropivacaine and levobupivacaine are thought to carry less potential for systemic and cardiac toxicity than bupivacaine [23]. While we routinely use ropivacaine at our institution for this reason, we also acknowledge that no levoenantiomer is free of toxicity risks, and any theoretical benefits tend to dissipate with higher doses [20]. Ropivacaine is certainly an acceptable choice for bilateral blocks, with the caveat that its relatively lower potency compared to bupivacaine should not lead practitioners to give excessive doses without worry, given that systemic toxicity can occur at higher doses.

Because addition of epinephrine does not reliably enhance or prolong blockade for long acting amide local anesthetics [24,25], we generally do not use epi-containing ropivacaine for peripheral nerve blocks. Epinephrine, however, is as good a marker of immediate intravascular injection as we currently have [20], and can reliably reduce systemic uptake in a variety of different block locations [26,27]. Addition of epinephrine may therefore be advisable when using higher doses of local anesthetic as may be required during bilateral blocks.

Patient selection

Numerous authors have noted that certain patient-specific comorbid conditions may predispose to the development of LAST, particularly extremes of age (<4months or >70 years), presence of cardiac conduction or ischemic disease, and concomitant renal or liver dysfunction [20,21]. Bilateral block techniques that require higher total doses of local anesthetic may therefore be less advisable in such patients, and should only offered to patients who have been carefully screened for the presence of such comorbid conditions which may predispose to toxicity.

Highlights

- Bilateral brachial plexus blocks may carry increased risks which can dissuade practitioners from offering them to patients undergoing bilateral upper extremity surgery.
- Local anesthetic systemic toxicity, respiratory complications, nerve injury, and blockade inadequate in distribution, density

or duration are all risks of peripheral blocks, but may be of even greater concern when attempting blockade of both sides.

- As long as careful consideration is given and slight modifications made to block technique, local anesthetic administration, and patient selection, bilateral brachial plexus blocks can be performed safely and effectively.

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