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Scientific Abstracts > Regional Anesthesia

Feasibility and safety of brachial plexus blocks in patients with cervical spinal cord injury undergoing upper extremity surgery

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Introduction

Cervical spinal cord injury (SCI) is life-altering, impacting a patient's independence, function, and quality of life. As a result, arm and hand function is a prioritized goal for those living with cervical SCI. Upper extremity reconstructive surgeries are well-established procedures that can improve and maintain function in SCI patients.(1) Despite the benefits of surgery, there may be hesitancy in referring patients with cervical SCI for surgical intervention due to perceived surgical risks. The altered physiology after cervical SCI results in unique surgical considerations such as autonomic dysreflexia triggered by pain below the level of SCI and constipation and urinary retention, which can be exacerbated by postoperative opioid use.(2)

A brachial plexus continuous peripheral nerve block (CPNB) is a safe technique used for painful upper extremity surgeries and may reduce reliance on opioids for analgesia. However, there is a paucity of literature available on peripheral nerve blocks for SCI patients who undergo extremity surgery. For instance, the ASRA Pain Medicine Advisory on Neurologic Complications Associated with Regional Anesthesia and Pain Medicine do not specifically discuss the use of regional anesthesia in patients with SCI.(3) Concerns for using brachial plexus CPNBs in patients with a cervical SCI include exacerbation of underlying pulmonary issues leading to increased risk for pneumonia, "double-crush" injury caused by a subsequent insult to a neural pathway with preexisting damage, and a SCI patient's intolerance of an insensate extremity.(2,4) In this case series, we present the successful application of brachial plexus CPNBs to the care of patients with SCI undergoing upper extremity tendon reconstructive surgery through examination of patient experiences of an insensate upper extremity, postoperative opioid use, and the return of bowel function.

Materials and Methods

This project took place at a tertiary care university-affiliated Veterans Affairs (VA) hospital with a Regional Anesthesia and Acute Pain Medicine Service (RAAPM) and a Hand Surgery Service. All patients with a cervical SCI undergoing upper extremity tendon transfers or reconstructive surgery receive a pre-operative ultrasound-guided brachial plexus CPNB placed by a RAAPM physician. An elastomeric infusion pump of 0.2% ropivacaine 6mL/hr plus 5mL on-demand bolus every 30 minutes is initiated in the post-anesthesia care unit. Patients are transferred to the on-campus SCI

unit with the CPNB infusion pump in place. Nurses on the SCI unit were in-serviced on the care of patients with a CPNB pump. The RAAPM service rounds daily on inpatients with CPNBs until the CPNB is discontinued. Postoperative analgesics are prescribed by SCI unit physicians.

With IRB approval and waiver of informed consent, a retrospective chart review was completed to evaluate patient experiences and outcomes with an insensate limb in the setting of SCI, postsurgical opioid use, and return of bowel function, defined as the first bowel movement after surgery, from the day of surgery (postoperative [POD] 0) up to POD 7. Return to preoperative (baseline) opioid use was also assessed. All patients were identified through a facility-based quality improvement database.(5)

Results/Case Report

From October 2017 to September 2023, fifteen patients met the inclusion criteria of having a cervical SCI, receiving upper extremity tendon transfers or reconstructive surgery, and having a preoperative brachial plexus CPNB. Sample characteristics are reported in Table 1. Type of surgery, intraoperative anesthetic, details on the CPNB experience, return of bowel function, and return to baseline opioid usage are reported in Table 2.

Four patients received a supraclavicular brachial plexus CPNB due to recent use of an anticoagulant (n=2) or anatomical anomaly on ultrasound (n=2); the rest received infraclavicular brachial plexus CPNB. Most patients had the CPNB discontinued on POD 3 when the pump reservoir was exhausted, but five patients continued the CPNB infusion with pump replacement until POD 5 (n=1) and POD 6 (n=4). No patients experienced neurologic complications from the CPNB. One patient with a supraclavicular brachial plexus CPNB reported shortness of breath, which improved with intermittent clamping of the CPNB infusion pump. One patient complained of excessive numbness, which resolved after decreasing the CPNB continuous infusion rate to 4mL/hr and clamping the infusion pump for 2 hours.

Three patients were on opioid therapy before surgery with daily morphine milligram equivalents (MME) ranging from 5mg to 82.5mg. The majority of patients returned to baseline daily MME use or weaned off opioids by POD 3. Patients who continued to use opioids above their baseline dose after POD 3 had a propensity to remain on opioids past POD 7 (Figure 1). Data on return to baseline daily MME use is missing for 5 patients due to continued opioid use beyond POD 7 (n = 4) or hospital discharge before POD 7 (n = 1).

Eleven patients had a bowel movement by POD 1, with 4 having a return of bowel function by POD 4. Almost all patients in this cohort had pre-existing long-term urinary catheterization or ostomy drainage which continued perioperatively.

Discussion

The use of brachial plexus CPNBs for postoperative analgesia in patients with cervical SCI undergoing upper extremity reconstruction surgery is a feasible and safe option. Brachial plexus CPNB infusions were well tolerated for 3-6 days after surgery by most patients. Several patients requested a refill of the CPNB infusion pump, which typically indicates a positive patient experience. No patients experienced any worsening of neurologic symptoms. Additionally, most patients returned to baseline daily MME usage by POD 5, and there were minimal issues with bowel or bladder function in the postoperative period.

References

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Disclosures

No

Tables / Images

Figure 1. Time series plots of the daily morphine milligram equivalent (MME) usage per patient from postoperative day (POD) 0 to POD 7. Thin lines represent each patient's daily MME. Thick lines represent the mean daily MME of opioid naïve and opioid-tolerant patients. Stars indicate the day of continuous peripheral nerve block removal.

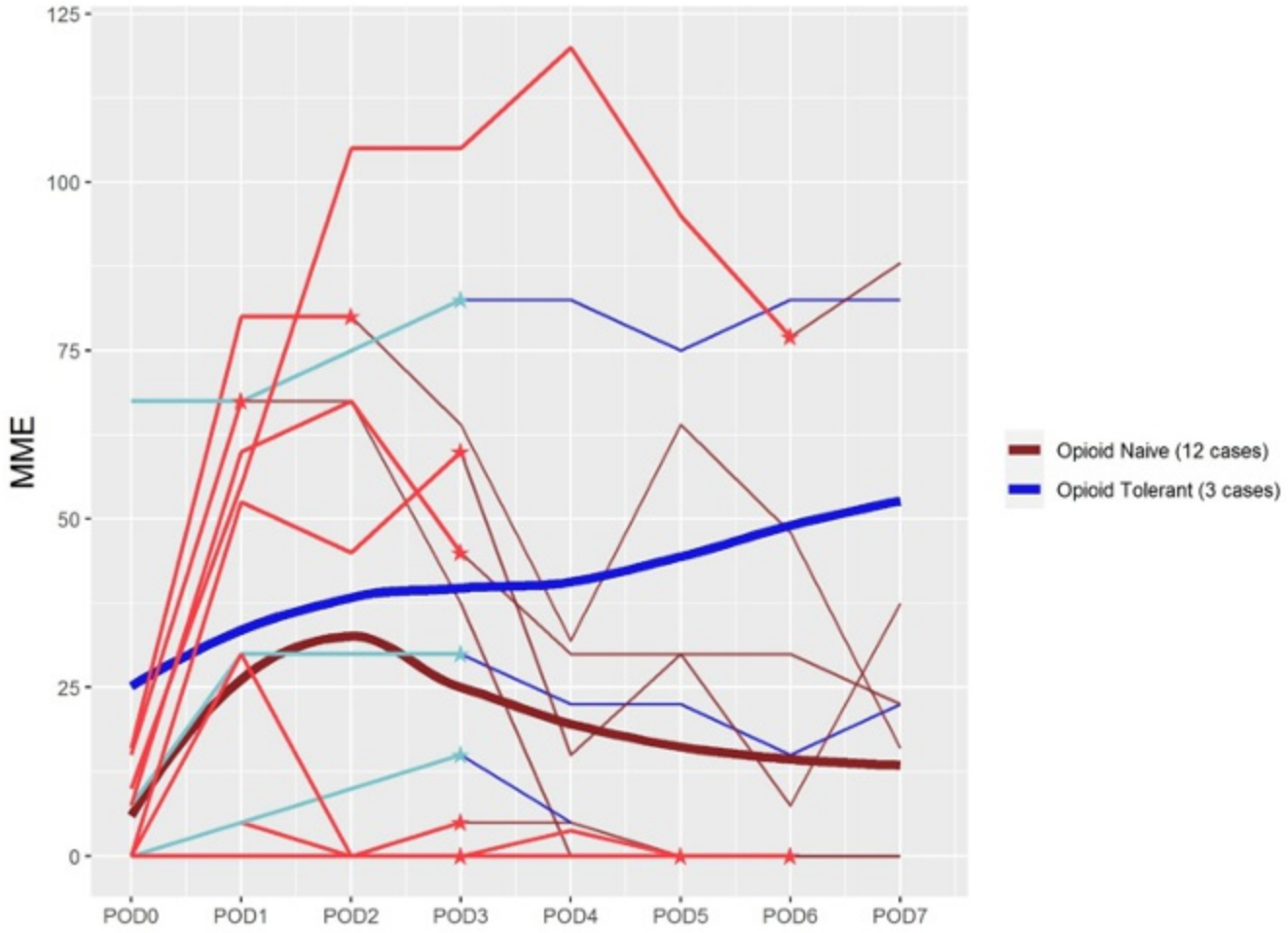

Table 1. Sample characteristics

Case	Age	Gender	ASA	ASIA	Baseline MMED
1	80s	M	3	C6 AIS B	30
2	50s	M	3	C6 AIS A	0
3	30s	M	3	C6 AIS A	0
4	50s	M	3	C6 AIS A	0
5	30s	M	3	C6 AIS A	0
6	80s	M	3	C1 AIS D	82.5
7	80s	M	3	C6 AIS C	0
8	30s	M	3	C4 AIS A	0
9	30s	M	3	C4 AIS A	0
10	40s	M	3	C3 AIS D	0
11	80s	M	3	C5 AIS C	0
12	70s	M	3	C3 AIS C	5
13	80s	M	3	C5 AIS C	0
14	70s	M	3	C7 AIS D	0
15	60s	M	3	C6 AIS D	0

ASA = American Society of Anesthesiologists physical status classification;
ASIA = American Spinal Injury Association Impairment Scale;
MMED = morphine milligram equivalents per day

Table 2. Perioperative characteristics

Case	Surgery	GA	CPNB type	Block removed	CPNB notes	Return of BMs	Return to baseline MMED
1	Tendon transfer	Y	Infraclavicular	POD 3	Incomplete coverage of block distribution	POD 1	POD 0
2	Tendon transfer	Y	Infraclavicular	POD 6	Pump refilled	POD 0	POD 2
3	Reconstruction	Y	Supraclavicular	POD 2	Shortness of breath	POD 1	Unknown
4	Reconstruction	Y	Infraclavicular	POD 5	None	POD 1	POD 0
5	Tendon transfer	Y	Supraclavicular	POD 3	Block removed so patient could transition heparin injection to oral anticoagulation	POD 0	Unknown
6	Tendon transfer	N	Infraclavicular	POD 3	None	POD 1	POD 0
7	Tendon transfer	N	Infraclavicular	POD 6	Pump refilled	POD 0	POD 0
8	Reconstruction	Y	Infraclavicular	POD 6	Pain is outside of block distribution	POD 1	Unknown
9	Tendon transfer	Y	Supraclavicular	POD 1	Catheter dislodged	POD 3	POD 4
10	Tendon transfer	Y	Infraclavicular	POD 3	Pump empty	POD 2	Unknown
11	Tendon transfer	N	Infraclavicular	POD 3	CPNB increased to 8mL/hr POD 2	POD 0	POD 5
12	Tendon transfer	N	Infraclavicular	POD 3	None	POD 1	Unknown
13	Tendon transfer	N	Infraclavicular	POD 6	Pump refilled	POD 4	POD 0
14	Tendon transfer	N	Supraclavicular, single injection suprascapular	POD 3	none	POD 1	POD 0
15	Tendon transfer	N	Infraclavicular	POD 3	POD 2 patient complaining of numbness – CPNB clamped for 2 hrs & decreased to 4mL/hr	POD 3	POD 2

GA = general anesthesia; CPNB = continuous peripheral nerve block; POD = postoperative day; BMs = bowel movements;
MMED = morphine milligram equivalents per day