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Case Report

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Continuous Supraclavicular Nerve Block for a Forearm Open Reduction and Internal Fixation in a Patient with an Anterior Mediastinal Mass

(Running title: A CPNB for a Patient with a Mediastinal Mass)

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Abstract

An anterior mediastinal mass (AMM) can cause life-threatening complications during general anesthesia due to compression of airway and vascular structures. Ultrasound-guided continuous peripheral nerve blocks (CPNB) with mild sedation allows for spontaneous ventilation and avoidance of complications associated with general anesthesia and airway manipulation for patients with an AMM. However, examples with adult patients in literature remain limited. We report a unique case in which a supraclavicular CPNB was used successfully as the primary anesthetic for a forearm open reduction internal fixation in a patient at risk for complications secondary to an AMM.

***Case Presentation:** The patient was a 54-year-old male. He presented with severe left forearm pain after a van struck him, and sustained injuries that included an open midshaft fracture of the left radius and ulna and a large left proximal forearm laceration. CT scan revealed a 5.5x4.4x5.7 cm well-defined cystic mass that extended into the upper mediastinum and deviated the trachea to the right with tracheal lumen narrowing. Given the risk of airway and hemodynamic collapse during general anesthesia resulting from the AMM mass effect, the acute pain service performed an ultrasound-guided supraclavicular CPNB for utilization as the primary anesthetic for the painful open reduction and internal fixation surgery. During the 3-day continuous left supraclavicular nerve block infusion, the patient reported no pain at rest or with passive stretch while utilizing only scheduled acetaminophen and minimal opioids.*

The use of a CPNB avoided the potential complications associated with general anesthesia and a potentially symptomatic AMM for A patient on two occasions. A supraclavicular CPNB produced additional short-term benefits for the patient including elimination of intraoperative opioid requirement, decreased postoperative opioids utilization, and minimization of breakthrough pain.

Keywords: *continuous peripheral nerve block, supraclavicular nerve block, anterior mediastinal mass, regional anesthesia, airway management.*

Glossary of Terms

- AMM: anterior mediastinal mass
- APS: acute pain service
- CADD: continuous ambulatory delivery device
- CPNB: continuous peripheral nerve blocks
- CT: computerized tomography
- HD: hospital day
- IRB: Institutional Review Board
- ORIF: open reduction and internal fixation
- UTHSC: University of Tennessee Health Science Center
- SCA: subclavian artery

Introduction

An anterior mediastinal mass (AMM) can cause severe and life-threatening complications related to compression of the airway and vascular structures during general anesthesia [1]. Ultrasound-guided continuous peripheral

nerve blocks (CPNB) carry safe and effective benefits in the acute trauma and perioperative setting [2]. Regional anesthesia has been shown to avoid potential complications associated with general anesthesia and an AMM in adult patients from an interscalene approach, but not repeated in literature for adult patients with an ultrasound-guided supraclavicular CPNB [3]. We report a unique case in which a continuous supraclavicular nerve block was successfully performed as the primary anesthetic and for post-operative pain management for an open reduction and internal fixation (ORIF) of the radius and ulna in a patient at risk for airway and cardiovascular complications secondary to AMM mass effect.

Case Report

A 54-year-old male presented to a Level 1 Trauma Center with severe left forearm pain and a Glasgow Coma Scale of 15 after being struck by a van. His injuries included an open midshaft fracture of the left radius and ulna and a large left proximal forearm laceration. His past medical history included acute anemia, obesity, and hyperlipidemia. Further imaging was obtained given the mechanism of injury. CT scan of the left lower neck revealed a 5.5 x 4.4 x 5.7 cm well-defined cystic mass that extended into the upper mediastinum, displaced the left thyroid lobe superiorly, and deviated the trachea to the right with tracheal lumen narrowing (Figure 1, Figure 2). The airway exam demonstrated normal mouth opening and neck mobility, thyromental distance >5cm, and tracheal deviation. Lung sounds were clear to auscultation and equal bilaterally. Review of systems was unremarkable, and the patient presented with no symptoms related to the AMM.

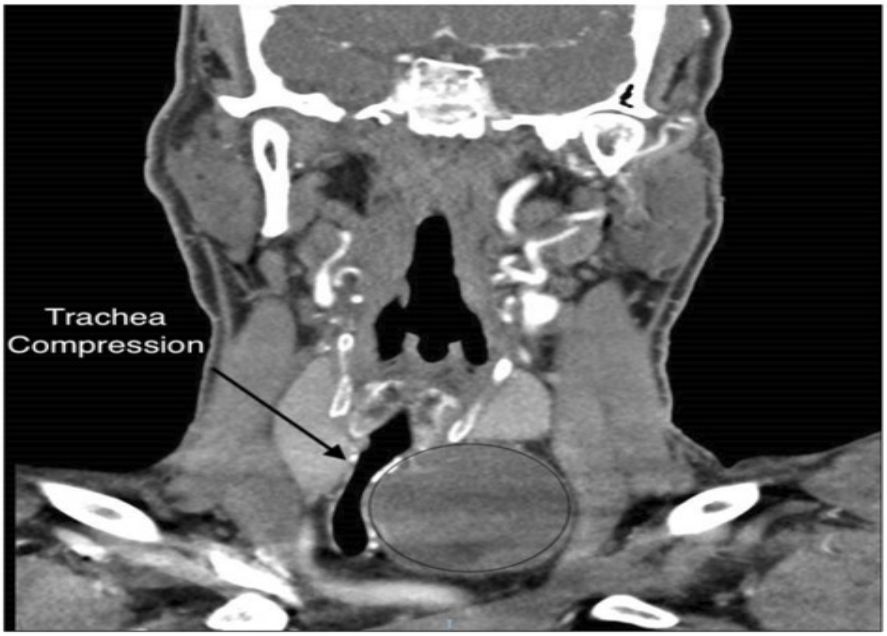

Figure 1

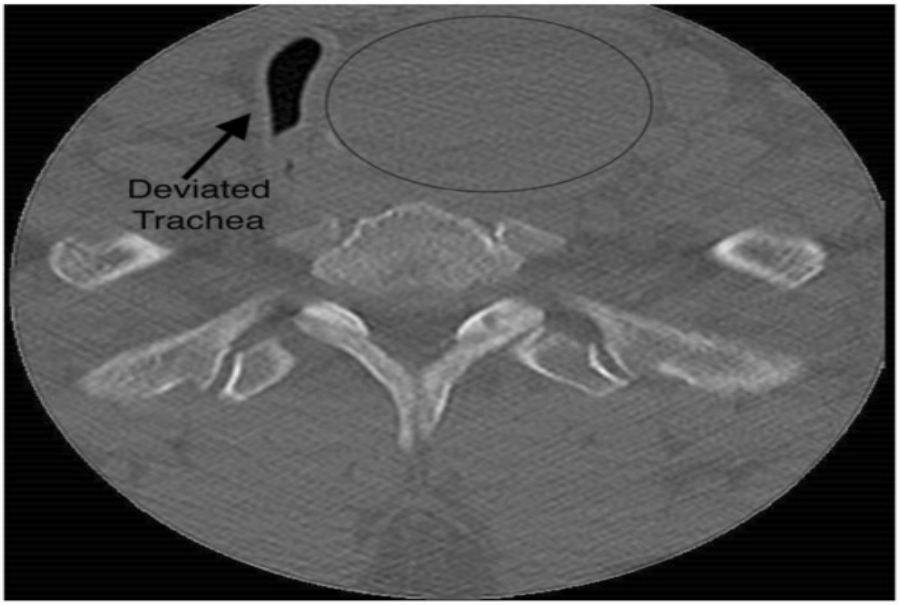

Figure 2

Trauma surgery performed a debridement and irrigation with wound closure urgently to avoid infection from the open wound on Hospital Day 1 (HD 1). The anesthesiologist performed a single injection left supraclavicular nerve block using a Tuohy needle (Contiplex, B Braun, Bethlehem, PA) with a bolus of 20 mL of 0.5% bupivacaine prior to the procedure as the primary anesthetic to avoid airway manipulation and positive pressure ventilation. The patient required no opioid administration intraoperatively.

Given the AMM neck extension, which could lead to atypical sonoanatomy of the brachial plexus and inadequate local anesthetic spread during the more painful definitive ORIF surgery, the orthopedic service consulted the Acute Pain Service (APS) to perform the supraclavicular CPNB for the procedure. Since the patient reported very little pain and required no opioids at the time of the initial APS consult on HD 4, APS performed an ultrasound-guided continuous left supraclavicular brachial plexus nerve block one day prior to the definitive surgery on HD 6 using a Tuohy needle (Contiplex, B Braun, Bethlehem, PA) with a bolus of 20 mL of 0.5% bupivacaine to confirm complete spread of local anesthetic in the brachial plexus (Figure 3).

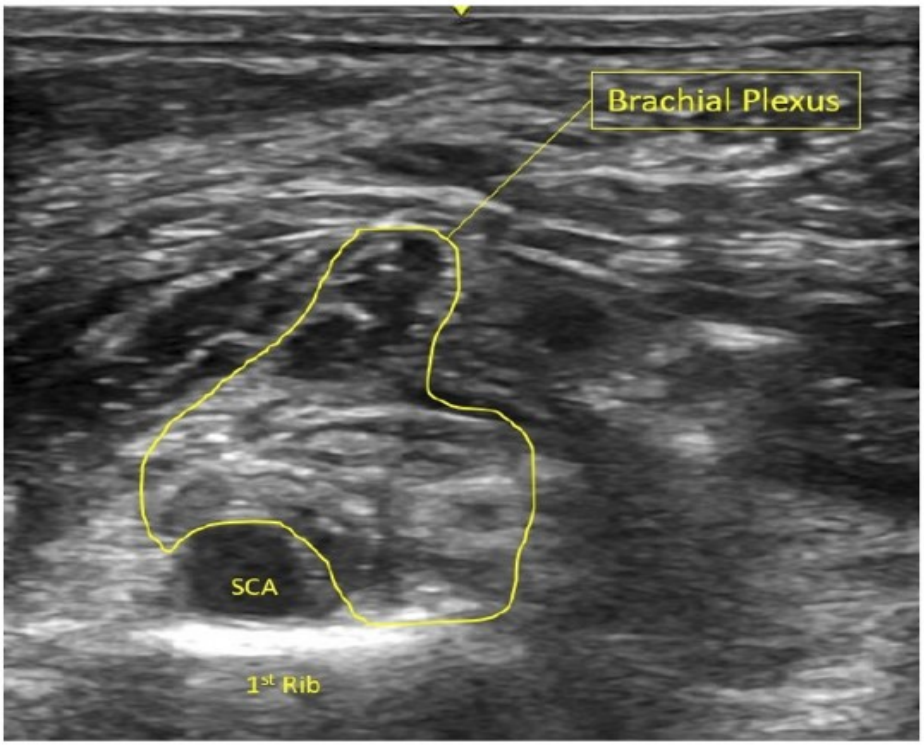

Figure 3

Sonoanatomy of the supraclavicular region demonstrated no atypical anatomy. After physical examination confirmed thorough local anesthetic spread within the brachial plexus, a continuous infusion of 0.125% bupivacaine at 12 mL/hr was initiated through an electronic infusion pump (CADD Solis infusion system, Smiths Medical, Dublin, OH).

Just prior to surgery on HD 7, APS bolused the supraclavicular nerve block catheter once again with 20 mL of 0.5% bupivacaine. A continuous infusion of intravenous dexmedetomidine at a rate of 0.6 mcg/kg/hr for sedation and small doses of ketamine were utilized intraoperatively (Table 1). Following the successful procedure, the patient was discharged home on post-operative day 1 (HD 8) after switching to a disposable elastomeric pump (On-Q, Avanos Medical, Irvine, California) infusing at an initial rate of 12 mL/hr to extend post-operative acute pain management and further reduce the requirement for opioids (Table 1).

(Hospital Day)	Opioids/Other				
	oxycodone, P.O.	*morphine*	*hydromorphone*	*ketamine*	**Surgery/Events**
HD 1	10 mg x3	4 mg x1	1 mg x1	20 mg x1*	**(1)** Debridement and Irrigation with Wound Closure **(2)** Single-injection Supraclavicular Nerve Block
HD 2	5 mg x1, 10 mg x2	0	0	0	
HD 3	0	0	0	0	
HD 4	0	0	0	0	
HD 5	0	0	0	0	
HD 6	10 mg x1	0	0	0	**(3)** Supraclavicular –CPNB performed
HD 7	0	2 mg x1	0	20 mg x2*	**(4)** Supraclavicular –CPNB Bolused **(5)** ORIF Radius and Ulna
HD 8	10 mg x2	0	0	0	**(6)** Patient Discharged
**Intraoperative administration*					

Table 1: Opioids and Ketamine received during course of hospitalization.

Discussion

Airway and hemodynamic collapse during general anesthesia are well-recognized complications for individuals with an AMM [1]. During induction of anesthesia and neuromuscular paralysis, bronchial smooth muscles relax, lung volumes reduce, and positive pressure ventilation will be required. The mass effect of the AMM during these physiologic changes can be unpredictable, making airway management difficult and maintenance of spontaneous ventilation vital [4]. Thus, the otolaryngology service was consulted prior to the ORIF of the radius and ulna. Their evaluation of the patient revealed a slow-growing, benign, mass: not of either thyroid or parathyroid origin. Further, they indicated that the mass did not require immediate resection and that the patient required follow up in their clinic.

Development of airway compression requires immediate intervention which includes patient repositioning, awakening the patient, rigid bronchoscopy, and pressure support ventilation. For life-threatening vascular compression, cardiopulmonary bypass or sternotomy with elevation of the mass from the compromised vasculature structures may be required [4]. Goh et al assert that a 50% obstruction of the airway below the lower trachea and main bronchi should prompt clinicians to prepare for femoral vessel cannulation and subsequent cardiopulmonary bypass [1]. The trauma surgery service noted that if complications related to the AMM occurred intraoperatively, the patient may require a salvage procedure via sternotomy due to the absence of cardiopulmonary bypass capabilities at our facility. However, based on the patient's exam and discussions between the orthopedic, trauma, and anesthesiology services, the team determined that the likelihood of the cardiopulmonary bypass requirement remained extremely remote.

Therefore, the team decided against transferring the patient to a facility with cardiopulmonary bypass as standby after assessing a risk-benefit ratio. The risk with cardiopulmonary bypass as a rescue for airway and cardiovascular collapse includes the time lost from arterial cannulation and securing circulation and oxygenation [4]. To mitigate the risk, the trauma surgery service remained immediately available throughout the surgery in the event of an emergent surgical airway or sternotomy. Because interventions for a compromised airway or hemodynamic insufficiency can be difficult or impossible to correct, CPNB should be considered for asymptomatic patients with an AMM whenever possible. CPNB allow patients to maintain spontaneous negative pressure ventilation and may completely remove the need for airway manipulation.

For this patient, the orthopedic and anesthesiology teams successfully utilized the nerve block as the primary anesthetic and performed the ORIF of the left radial and ulnar shaft without complications. Throughout the procedure, the patient maintained spontaneous respirations and an easily arousable state. The use of regional anesthesia in this case avoided the potential complications associated with general anesthesia and a potentially symptomatic AMM for the patient on two occasions. A continuous supraclavicular nerve block produced additional short-term benefits for the patient

including elimination of intraoperative opioid requirement, decreased postoperative opioids utilization, minimization of breakthrough pain, and possibly reduced length of stay due to decreased opioid-related adverse drug events [1, 5]. During the 3-day continuous left supraclavicular nerve block infusion, the patient reported no pain at rest or with passive stretch while utilizing only scheduled acetaminophen and minimal opioids.

The patient may have benefitted further if a CPNB was performed initially instead of a single-injection block. However, APS staff was unavailable to insert a continuous catheter the evening of his admission, and the surgeon was prepared to supplement the nerve block if local anesthetic spread was inadequate for the less invasive initial procedure. Fortunately, the patient required little to no opioids leading up to the time of his final surgery.

Relative to single-injection nerve blocks, CPNB are associated with less nausea, higher patient satisfaction scores, decreased rating of worst pain, and decreased overall opioid use [2]. Furthermore, repeated nerve block injections with single-injection nerve blocks in the same location and over a short timeframe are associated with possibly greater risk for nerve injury due to the reduced ability of partially anesthetized patients to warn of injury during re-injections [6]. Moreover, the risk of pneumothorax from a supraclavicular approach and nerve injury from needle penetration are also valid concerns. However, these risks, particularly when weighed against the risk of alternative anesthetic options, remain low with ultrasound guidance and clinical experience [7]. Consideration was given to an *infraclavicular* approach, which provides analgesia to structures distal to the elbow, but not utilized given the proximal extension of the left forearm laceration. Furthermore, ultrasound evaluation of both sites demonstrated a more direct and superficial needle approach for the supraclavicular location, reducing pneumothorax risk.

Discussions with the orthopedic surgeon revealed a very low risk for acute compartment syndrome. However, if concern from the orthopedic surgeon was high for a nerve block masking an acute compartment syndrome, [8] a CPNB using a short-acting local anesthetic for each surgery may have been a viable option for intraoperative management. Other regional anesthesia techniques, such as *interscalene* nerve blocks, have been utilized for patients with an AMM [9]. However, the interscalene nerve block is associated with ulnar sparing which was inadequate for the ORIF of the radius and ulna. Further, interscalene nerve blocks are associated with a higher risk of phrenic nerve palsy compared to a supraclavicular or infraclavicular approach which could potentially compromise spontaneous respiratory efforts [10]. The patient exhibited no signs of phrenic nerve palsy, local infection, local anesthetic systemic toxicity, or nerve injury.

Conclusion

This case demonstrates the feasibility of effectively utilizing a supraclavicular CPNB as the primary anesthetic in lieu of general anesthesia to avoid the potential risk of airway and cardiovascular compromise in a patient with an AMM. Though a supraclavicular CPNB is a more advanced technique, patients presenting with an AMM who require upper extremity surgery should prompt anesthesiologists to consider similar approaches given the significant risks associated with general anesthesia. Further investigation is needed to determine the relative risks and benefits of a supraclavicular approach compared to similar techniques such as the infraclavicular and axillary approach. Studies evaluating optimal dosing strategies and the incidence of an AMM obstructing brachial plexus local anesthetic spread in patients requiring upper extremity surgery are needed as well.

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