CLINICAL VIGNETTE

Axillary Nerve Block for Upper Extremity Arteriovenous Fistula Creation

Claudia L. Cao, M.D., and Peter G. Lee, M.D.

Background

Anesthesia for upper extremity arteriovenous (AV) fistula creation can be performed under general anesthesia, regional anesthesia, or local anesthesia. Avoiding general anesthesia may be desirable in this population, and, under most circumstances, AV fistula creation can be accomplished using regional or local anesthesia with or without intravenous sedation. The ultrasound-guided axillary nerve block is one regional anesthesia technique that blocks the brachial plexus for upper extremity surgery and may offer unique benefits for creation of AV fistula surgeries.

Case

A 39-year-old morbidly obese Hispanic female was scheduled for left brachial-basilic fistula creation. Her medical history was remarkable for hypertension; congenital heart disease, including a small ventricle septal defect, patent foramen ovale, and bicuspid aortic valve; and end stage renal disease secondary to hypertension on hemodialysis via Permacath. She was status post multiple failed AV fistulas, presented for left brachial-basilic fistula creation for long-term hemodialysis access. Her anesthetic history was remarkable for conversion from monitored anesthetic care (local anesthesia with intravenous sedation) to general anesthesia secondary to intraoperative pain and anxiety during a previous fistula creation as well as a panic attack during a transesophageal echocardiogram under monitored anesthesia care with intravenous sedation. The patient also reported, however, that she had previously undergone AV fistula creation under regional anesthesia with an axillary block without issues. Given her multiple medical co-morbidities and prior success with regional anesthesia, the anesthesia team decided to proceed with an axillary nerve block with intravenous sedation as needed.

Despite the patient's morbid obesity, her pertinent anatomical structures were easily identified under ultrasound, and an ultrasound-guided axillary nerve block was completed using 30 mL of 0.5% ropivacaine. The patient tolerated the nerve block well with minimal premedication with midazolam and fentanyl. Intraoperatively, she exhibited no reaction to surgical stimulation and required only a low dose propofol infusion for sedation. She remained hemodynamically stable throughout the surgery and subsequently had an uneventful and rapid recovery from anesthesia in the post anesthesia care unit before being discharged home the same day.

Discussion

Regional anesthesia and the use of peripheral nerve blocks have been in practice for decades and with the advancement of technology, ultrasound-guidance for peripheral nerve blocks has become a popular method of block delivery. Before the availability of ultrasounds, peripheral nerve blocks were completed blindly using nerve stimulators and external anatomical landmarks, however, with the use of ultrasound, the clinician can now visualize the needle, nerves, vasculature, and soft tissue during a block and the location of local anesthetic deposition. Studies have shown that ultrasound-guided peripheral nerve blocks require lesser volumes of local anesthetic,[1] shorter time to sensory blockade,[2] decreased procedure-related pain,[2] lesser number of needle passes,[2] and an increased rate of block success.[3]

The axillary block along with interscalene, supraclavicular, and infraclavicular blocks offer several approaches to ultrasound-guided blockade of the brachial plexus for upper extremity procedures. The interscalene approach is the highest block delivered to the brachial plexus at the roots and trunks of C3-C7, and sometimes misses C8-T1, resulting in ulnar sparing. The supraclavicular approach blocks the trunks of the brachial plexus when they travel closely together and the infraclavicular approach blocks the cords of the brachial plexus. Finally, the axillary block targets the individual nerves of the brachial plexus in the axillary sheath including the radial, median, and ulnar nerves. A separate deposit of local anesthetic is required to block the musculocutaneous nerve coursing within the coracobrachialis muscle adjacent to the axillary sheath.

In general, all four methods of blocking the brachial plexus have equal success rates of providing surgical analgesia using similar volumes of local anesthetic with minimal risk of major neurovascular injury.[4] Advantages of the axillary block over other methods include possible shorter procedure time with fewer needle passes[5] and lower likelihood of complications such as pneumothorax, hoarseness, hemi-diaphragm paralysis, and Horner's syndrome (by virtue of injecting local anesthetic farther away from structures such as the lung, recurrent laryngeal nerve, phrenic nerve, and sympathetic ganglia).[6] Although with the advent of ultrasound guidance, complications associated with higher brachial plexus block such as pneumothorax with supraclavicular approach have diminished.[7] Drawbacks of the axillary approach include slower onset and shorter duration of analgesia compared to higher blocks.[5]

For the subset of patients with end stage renal disease undergoing AV fistula formation, regional anesthesia offers additional advantages over other forms of anesthesia. In contrast to local anesthesia or general anesthesia, regional blockade of the brachial plexus blocks sympathetic innervation to the vasculature of the surgical limb. The sympathectomy results in arterial and venous vasodilation and decreased vasospasm, which may allow surgeons to create a more distal AV fistula and spare more proximal sites for future fistulas.[8] Axillary block has also been shown to increase blood flow through new fistulas and decrease maturation time.[9] It is unclear if these benefits help significantly decrease primary AV fistula failure.[10]

Aside from optimizing vascular conditions for AV fistula creation, an axillary block with sedation provides this high-risk patient population with a safer alternative to general anesthesia with the avoidance of airway instrumentation, larger hemodynamic changes, and post-operative complications such as nausea/vomiting. Furthermore, peripheral nerve blocks utilizing a long-acting local anesthetic such as ropivacaine could reduce post-operative pain and opioid consumption[11] and decrease time to discharge.

Conclusion

The ultrasound-guided axillary nerve block is an effective method of achieving surgical analgesia for upper limb surgery with less risk of complications compared to general anesthesia and even other forms of brachial plexus blocks. The associated sympathetic block and vascular vasodilation is particularly helpful with AV fistula creations, potentially allowing for more distal fistula creation sites and may improve fistula patency. In the setting of this clinical vignette, the axillary block with propofol sedation was an optimal anesthetic plan for an anxious patient with multiple medical comorbidities undergoing a repeat AV fistula creation.

REFERENCES

1. **Casati A, Baciarello M, Di Cianni S, Danelli G, De Marco G, Leone S, Rossi M, Fanelli G**. Effects of ultrasound guidance on the minimum effective anaesthetic volume required to block the femoral nerve. *Br J Anaesth.* 2007 Jun;98(6):823-7. Epub 2007 May 3. PubMed PMID: 17478453.
2. **Casati A, Danelli G, Baciarello M, Corradi M, Leone S, Di Cianni S, Fanelli G.** A prospective, randomized comparison between ultrasound and nerve stimulation guidance for multiple injection axillary brachial plexus block. *Anesthesiology.* 2007 May;106(5):992-6. PubMed PMID: 17457131.
3. **Chan VW, Perlas A, McCartney CJ, Brull R, Xu D, Abbas S.** Ultrasound guidance improves success rate of axillary brachial plexus block. *Can J Anaesth*. 2007 Mar;54(3):176-82. Erratum in: Can J Anaesth. 2007 Jul;54(7):594. PubMed PMID:17331928.
4. **Albrecht E, Mermoud J, Fournier N, Kern C, Kirkham KR.** A systematic review of ultrasound-guided methods for brachial plexus blockade. *Anaesthesia*. 2016 Feb;71(2):213-27. doi: 10.1111/anae.13347. Epub 2015 Dec 16. Review. PubMed PMID:26670119.
5. **Arnuntasupakul V, Leurcharusmee P, Chora De La Garza D, Ah-Kye S, Finlayson RJ, Tran DQ.** A randomized trial comparing axillary block versus targeted intracluster injection supraclavicular block for upper limb surgery. *Can J Anaesth*. 2015 Dec;62(12):1287-94. doi: 10.1007/s12630-015-0485-x. Epub 2015 Oct 2. PubMed PMID: 26431854.
6. **Thompson AM, Newman RJ, Semple JC.** Brachial plexus anaesthesia for upper limb surgery: a review of eight years' experience. *J Hand Surg Br.* 1988 May;13(2):195-8. PubMed PMID: 3385299.
7. **Chan VW, Perlas A, Rawson R, Odukoya O.** Ultrasound-guided supraclavicular brachial plexus block. *Anesth Analg.* 2003 Nov;97(5):1514-7. PubMed PMID:14570677.
8. **Laskowski IA, Muhs B, Rockman CR, Adelman MA, Ranson M, Cayne NS, Leivent JA, Maldonado TS.** Regional nerve block allows for optimization of planning in the creation of arteriovenous access for hemodialysis by improving superficial venous dilatation. *Ann Vasc Surg.* 2007 Nov;21(6):730-3. Epub 2007 Aug 20. PubMed PMID:17703918.
9. **Malinzak EB, Gan TJ.** Regional anesthesia for vascular access surgery. *Anesth Analg*. 2009 Sep;109(3):976-80. doi: 10.1213/ane.0b013e3181adc208. Review. PubMed PMID: 19690276.
10. **Nofal WH, El Fawal SM, Shoukry AA, Sabek E, Malak W**. Ultrasound-guided axillary brachial plexus block versus local infiltration anesthesia for arteriovenous fistula creation at the forearm for hemodialysis in patients with chronic renal failure. *Saudi J Anaesth*. 2017 Jan-Mar;11(1):77-82. doi:10.4103/1658-354X.197355. PubMed PMID: 28217059; PubMed Central PMCID:PMC5292858.
11. **Liu Q, Chelly JE, Williams JP, Gold MS.** Impact of peripheral nerve block with low dose local anesthetics on analgesia and functional outcomes following total knee arthroplasty: a retrospective study. *Pain Med*. 2015 May;16(5):998-1006. doi:10.1111/pme.12652. Epub 2014 Dec 28. PubMed PMID: 25545781; PubMed Central PMCID:PMC4674268.

Submitted April 6, 2017