International Journal of Medical Anesthesiology

E-ISSN: 2664-3774
P-ISSN: 2664-3766
www.anesthesiologypaper.com
IJMA 2022; 5(4): 04-06
Received: 03-09-2022
Accepted: 05-10-2022

Dr. P Akshara
Senior Resident,
Department of Anaesthesiology,
Shri Sathya Sai Medical College and Research Institute,
Ammapettai, Tamil Nadu, India

Dr. J Arunashreya
Assistant Professor,
Department of Anaesthesiology,
Shri Sathya Sai Medical College and Research Institute,
Ammapettai, Tamil Nadu, India

Dr. V Madhumitha
Assistant Professor,
Department of Emergency Medicine,
Shri Sathya Sai Medical college and Research Institute,
Ammapettai, Tamil Nadu, India

Corresponding Author:
Dr. P Akshara
Senior Resident,
Department of Anaesthesiology,
Shri Sathya Sai Medical College and Research Institute,
Ammapettai, Tamil Nadu, India

Analgesic adjuvants for brachial plexus block: A narrative review

Dr. P Akshara, Dr. J Arunashreya and Dr. V Madhumitha

DOI: https://doi.org/10.33545/26643766.2022.v5.i4a.362

Abstract
Ultrasound guided brachial plexus block is gaining importance as it provides excellent surgical anaesthesia, nonsurgical analgesia, immobilisation of limb and reduces general anaesthesia related side effects. The technique also has the advantage of visualisation of needle towards the nerve of interest and deposition of drug with immediate anaesthesia and patient satisfaction thereby decreasing the chances of vascular injury. Local anaesthetics when given in large doses can cause systemic toxicity whereas when given as single shot or in smaller dose fail to either produce desired effect or duration of action exposing the patient to the pain of surgical trauma. To overcome this, various class of drugs have been used as adjuvants to local anaesthetics and their efficacy are studied through the quality of block produced, known as analgesic adjuvants. In this review, we aim to discuss a few studies regarding the use of various adjuvants for brachial plexus block and provide current evidence for use and also summarizes the best strategies for optimizing pain control and reducing adverse effects after surgery under brachial plexus block.

Keywords: Brachial plexus block, analgesic adjuvants, local anaesthetic adjuvants

Introduction
Analgesic techniques must keep pace with the recent advances in surgical techniques which with the development of a greater number of minimally invasive procedures have led to an increase in outpatient procedures [1]. Surgeries of upper limb can be either done under general anaesthesia or brachial plexus block [2]. Balanced anaesthesia with multiple injection of drugs to satisfy various components of anaesthesia is required in general anaesthesia-Benzodiazipines to produce anxiolysis and amnesia, Induction agents to produce unconsciousness, Inhalational agents to prevent awareness and Opioids to produce analgesia. Whereas in peripheral nerve block, a single injection administered in the vicinity of the specific nerve or nerve bundles produces analgesia, anaesthesia and immobility of the limb preventing poly pharmacy and better patient outcomes [3]. One such technique is Brachial plexus block which has become a sole anaesthetic modality in most of upperlimb surgeries. Approaches of Brachial plexus block include–Supraclavicular, Infraclavicular, Interscalene and Axillary with each of them having their own merits and demerits. Invent of Ultrasound has made this technique more successful as it aides in better visualization of needle and distribution of drug [4].

Local anaesthetic drugs reversibly bind with the sodium channels, thereby preventing the transmission of impulses in nerve fibres and eliminate sensation. However duration of analgesia even with long acting local anaesthetics wear offs and to overcome this, various class of drugs have been used along with local anaesthetics known as adjuvants to prolong the analgesic effects [3].

These analgesic adjuvants include opioids, N-methyl-aspartate (NMDA) antagonists-Ketamine and Magnesium sulphate, Dexamethasone, Dexmedetomidine. Importantly, none has demonstrated neurotoxicity at clinically relevant concentrations [5].

Role of adjuvants in brachial plexus block
Opioids
Opioids, the most common and primitive adjuvant used, act by potentiating the anti-nociception property of local anesthetic drugs. The opioids are in use since their receptor discovery in substansia gelatinosa of dorsal root ganglion.

Opioid receptors incorporated into the neuronal membrane causes hyperpolarization of the afferent neuron through suppression of calcium ions, cyclic AMP release or potentiates potassium influx and subsequent attenuation of substance P release in PNB. These receptors while undergoing axonal transport, might not be easily reached by their agonists unlike their usual transport to site of inflammation. This may explain little evidence found in adding opioids to local anaesthetics for peripheral nerve blockade [3, 5].

Among opioids, Buprenorphine has shown better analgesic efficacy owing to its high receptor affinity. Buprenorphine is partial opioid agonist, lipophilic drug which when added to local anaesthetics doubled it duration of action. Limitation of its use perineurally is due to its increased incidence to cause PONV [6-7].

Anti-inflammatory agent/steroid

Dexamethasone, synthetic corticosteroid with very little mineralocorticoid activity several times potent than any other steroid in its antiemetic property, effectiveness of which has been confirmed through several studies. Owing to its anti-inflammatory property, its single intravenous dose has efficiently reduced postop pain successfully for up to 24 hours post administration. The mechanism of action of dexamethasone perineurally includes inhibiting the release of inflammatory mediators and preventing neuronal transmission by inhibiting potassium channel–mediated discharge of nociceptive C-fibers thereby improving the quality and duration of peripheral nerve block [5].

A dose of 8 mg can prolong duration of analgesia effectively. Parrington *et al.* showed addition of dexamethasone as an adjuvant effectively prolonged the duration of analgesia but had no effects on onset of sensory and motor block similar to the control group which used saline instead of dexamethasone. Only one *in vitro* study showed risk of neurotoxicity in mice model that caused neuronal death [8-11].

NMDA receptor antagonist

Ketamine being famous for its neuraxial effects, have been studied minimally as an adjuvant in brachial plexus block. According to Lee *et al.*, use of ketamine with local aanesthetic drug in nerve blocks instead of showing desired effects on the sensory or motor nerve blockade, showed adverse events like hallucination, nausea, and drowsiness [12]. Hence, the use of ketamine as an adjuvant has limited role and no longer used in peripheral nerve blocks.

Magnesium sulphate as an adjuvant in nerve blocks is not recommended owing to contribution of evidence from only few clinical trials [13-18].

Alpha 2 agonist

Dexmedetomidine is an agonist at α2-adrenergic receptor which is a highly selective in action, under the imidazole subclass which is a pharmacologically active dextrorotatory S-enantiomer of medetomidine. It acts through a receptor which is different from the γ-aminobutyric receptor utilized by drugs like benzodiazepines and propofol [19].

The uses of Dexmedetomidine includes Premedication (sedative, anxiolytic, and analgesic, sympatholytic and anti-sialagogue properties), as an adjunct to general anaesthesia and regional anaesthesia, Cardiovascular anaesthesia, Neuro anaesthesia, Post-operative analgesia and sedation, Sedation in ICU, for de-addiction treatment [20]. Hypotension, hypertension, and bradycardia are the established adverse effects caused by action on alpha 2A receptors causing reduced release of noradrenaline from sympathetic nervous system.

RM Hashim *et al*. found that among the three adjuvants used – dexmedetomidine recorded effective results with prolonged sensory and motor block as well as intraoperative surgical analgesia when compared to ketamine and fentanyl. Dexmedetomine and ketamine showed prolonged postoperative analgesia than fentanyl [21].

MA Hamed *et al*. reported that addition of dexmeditomidine to local anaesthetic drug such as bupivacaine in USG guided nerve block recorded desired effects of rapid onset of action of both motor as well as sensory block and prolonged duration of analgesia when compared to fentanyl added to bupivacaine [22].

Farooq *et al.* in their study showed that addition of fentanyl and Dexmedetomidine were nearly equal effective in extending the duration of Ropivacaine in ultrasound-guided brachial plexus block. This may be due to the use of Ropivacaine rather than bupivacaine as Ropivacaine has a longer duration of action, and the effect of adjuvants may not appear [23].

Conclusion

Among the analgesic adjuvants added to local anaesthetics to produce effective surgical anaesthesia and postoperative analgesia for brachial plexus block, Dexmedetomidine is becoming the most preferred adjuvant due to prolonged duration of action, fewer adverse effects and excellent quality of anaesthesia

Conflict of Interest

Not available

Financial Support

Not available

References

1. Chang A, Dua A, Singh K, White BA. Peripheral nerve blocks. Stat Pearls [Internet]; c2021 Sep 2. Available from: https://www.ncbi.nlm.nih.gov/books/NBK459210/
2. Héroux J, Belley-Côté E, Echavé P, Loignon MJ, Bessette PO, Patenaude N *et al*. Functional recovery with peripheral nerve block versus general anesthesia for upper limb surgery: a systematic review protocol. Systematic Reviews. 2019 Dec;8(1):1-7.
3. Prasad GK, Khanna S, Jaishree SV. Review of adjuvants to local anesthetics in peripheral nerve blocks: Current and future trends. Saudi Journal of Anaesthesia. 2020 Jan;14(1):77.
4. Song L, Tan S, Chen Q, Li H. Effect of Fentanyl as an Adjuvant to Brachial Plexus Block for Upper Extremity Surgeries: A Systematic Review and Meta-Analysis of RCTs. Pain Research and Management. 2022 Mar 19;2022. Available from: https://www.hindawi.com/journals/prm/2022/8704569/
5. McCartney CJ, Choi S. Analgesic adjuvants in the peripheral nervous system. Textbook of regional anesthesia. Mc Graw Hill, New York. 2007, 149.
6. Koppert W, Ihmsen H, Körber N, Wehrfritz A, Sittl R, Schmelz M, *et al*. Different profiles of buprenorphine-

induced analgesia and antihyperalgesia in a human pain model. Pain. 2005 Nov 1;118(1-2):15-22.
7. Bazin JE, Massoni C, Bruelle P, Fenies V, Groslier D, Schoeffler P. The addition of opioids to local anaesthetics in brachial plexus block: the comparative effects of morphine, buprenorphine and sufentanil. Anaesthesia. 1997 Sep;52(9):858-62.
8. Choi S, Rodseth R, McCartney CJ. Effects of dexamethasone as a local anaesthetic adjuvant for brachial plexus block: A systematic review and meta-analysis of randomized trials. British journal of anaesthesia. 2014 Mar 1;112(3):427-39.
9. Attardi B, Takimoto K, Gealy R, Severns C, Levitan ES. Glucocorticoid induced up-regulation of a pituitary K+ channel mRNA *in vitro* and *in vivo*. Receptors Channels. 1993;1:287-93.
10. Parrington SJ, O'Donnell D, Chan VW, Brown-Shreves D, Subramanyam R, Qu M, *et al*. Dexamethasone added to mepivacaine prolongs the duration of analgesia after supraclavicular brachial plexus blockade. Reg Anesth Pain Med. 2010;35:422-6.
11. Dani C, Vestri V, Bertini G, Pratesi S, Rubaltelli FF. Toxicity of corticosteroids and catecholamines for mice neuronal cell cultures: Role of preservatives. J Matern Fetal Neonatal Med. 2007;20:325-33
12. Lee IO, Kim WK, Kong MH, Lee MK, Kim NS, Choi YS, *et al*. No enhancement of sensory and motor blockade by ketamine added to ropivacaine interscalene brachial plexus blockade. Acta Anaesthesiol Scand. 2002;46:821-6.
13. Lee AR, Yi HW, Chung IS, Ko JS, Ahn HJ, Gwak MS, *et al*. Magnesium added to bupivacaine prolongs the duration of analgesia after interscalene nerve block. Can J Anaesth J Can Anesth. 2012;59:21-7.
14. ELShamaa HA, Ibrahim M, Eldesuky Hl. Magnesium sulfate in femoral nerve block, does postoperative analgesia differ? A comparative study. Egypt J Anaesth. 2014;30:169-73.
15. Gunduz A, Bilir A, Gulec S. Magnesium added to prilocaine prolongs the duration of axillary plexus block. Reg Anesth Pain Med. 2006;31:233-6.
16. Dogru K, Yildirim D, Ulgey A, Aksu R, Bicer C, Boyaci A. Adding magnesium to levobupivacaine for axillary brachial plexus block in arteriovenous fistule surgery. Bratisl Lek Listy. 2012;113:607-9.
17. Vastani N, Seifert B, Spahn DR, Maurer K. Sensitivities of rat primary sensory afferent nerves to magnesium: Implications for differential nerve blocks. Eur J Anaesthesiol. 2013;30:21-8.
18. Saeki H, Matsumoto M, Kaneko S, Tsuruta S, Cui YJ, Ohtake K, *et al*. Is intrathecal magnesium sulfate safe and protective against ischemic spinal cord injury in rabbits.? Anesth Analg. 2004;99:1805-12, table of contents
19. Wunsch H, Kress JP. A new era for sedation in ICU patients. JAMA - Journal of the American Medical Association. JAMA. 2009; 301:542-4.
20. Gertler R, Brown HC, Mitchell DH, Silvius EN. Dexmedetomidine: A Novel Sedative-Analgesic Agent. Baylor Univ Med Cent Proc. 2001 Jan;14(1):13-21.
21. Hashim RM, Hassan RM. The efficacy of adjuvants to bupivacaine in ultrasound-guided supraclavicular block: A comparative study between dexmedetomidine, ketamine, and fentanyl. Ain-Shams Journal of Anesthesiology. 2019 Dec;11(1):1-8.
22. Hamed MA, Ghaber S, Reda A. Dexmedetomidine and fentanyl as an adjunct to bupivacaine 0.5% in supraclavicular nerve block: A randomized controlled study. Anesthesia, essays and researches. 2018 Apr;12(2):475.
23. Farooq N, Singh RB, Sarkar A, Rasheed MA, Choubey S. To evaluate the efficacy of fentanyl and dexmedetomidine as adjuvant to ropivacaine in brachial plexus block: A double-blind, prospective, randomized study. Anesthesia, essays and researches. 2017 Jul;11(3):730

How to Cite This Article
Akshara P, Arunashreya J, Madhumitha V. Analgesic adjuvants for brachial plexus block: A narrative review. International Journal of Medical Anesthesiology. 2022;5(4):04-06.