

To Compare the Efficacy of Fentanyl versus Clonidine with Ropivacaine 0.5% in Supraclavicular Brachial Plexus Block in Terms of Duration of Sensory and Motor Blockade

Rajveer Kanojiya¹, Shikha Jain², Harsharan Singh³, Priya Patidar⁴

¹PG Student, Amaltas Institute of Medical Sciences, Dewas, M.P.

²Assistant Professor, Amaltas Institute of Medical Sciences, Dewas, M.P.

³PG Student, Amaltas Institute of Medical Sciences, Dewas, M.P.

⁴Assistant Professor, Amaltas Institute of Medical Sciences, Dewas, M.P.

Received: 18-07-2024 / Revised: 03-08-2024 / Accepted: 22-08-2024

Corresponding Author: Dr. Priya Patidar

Conflict of interest: Nil

Abstract:

Background & Methods: The aim of the study is to compare the efficacy of fentanyl versus clonidine with ropivacaine 0.5% in supraclavicular brachial plexus block in terms of duration of sensory and motor blockade. All 80 patients underwent thorough preoperative assessment, which encompassed a comprehensive review of medical history, a detailed general physical examination, systemic evaluation, airway assessment, and standard laboratory investigations including hemoglobin levels, total and differential white blood cell counts, bleeding time, clotting time, platelet count, blood glucose levels, blood urea levels, and serum creatinine levels. Additionally, electrocardiography and chest X-ray examinations were conducted.

Results: Duration of Motor Block: The mean duration of motor block was 417.43 ± 68.55 minutes for the Ropivacaine + Fentanyl group and 481.08 ± 66.76 minutes for the Ropivacaine + Clonidine + NS group, with a P-value of 0.0001. This indicates a statistically significant difference, with the Ropivacaine + Clonidine + NS group having a longer duration of motor block. Duration of Sensory Block: The mean duration of sensory block was 460.60 ± 66.10 minutes for the Ropivacaine + Fentanyl group and 529.10 ± 69.54 minutes for the Ropivacaine + Clonidine + NS group, with a P-value of <0.0001 . This shows a statistically significant difference, with the Ropivacaine + Clonidine + NS group having a longer duration of sensory block.

Conclusion: The findings of this study suggest that both clonidine and fentanyl, when added to 0.5% ropivacaine for supraclavicular brachial plexus blocks, enhance the efficacy of the block, but with distinct differences. Fentanyl significantly shortened the onset of both sensory and motor block but clonidine prolonged the both duration of sensory and motor block compared to fentanyl. This aligns with existing literature, which also supports the superior efficacy of clonidine as well as dexmedetomidine as adjuvants in prolonging block duration and enhancing analgesic effects.

Keywords: Efficacy, Fentanyl, Clonidine, Ropivacaine, Supraclavicular, Sensory And Motor Blockade.

Study Design: Observational Study.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Pain and its management have posed a persistent challenge throughout human history. Despite advancements in medicine, finding comprehensive solutions for pain relief remains elusive[1]. The effective alleviation of pain is paramount, as it underpins the success of surgical interventions and medical treatments [2].

The term "pain" originates from the Latin word "poena," signifying punishment. According to the International Association for the Study of Pain (IASP), pain is defined as "an unpleasant sensory and emotional perception linked to actual or potential tissue injury, or expressed in terms of such injury" [3].

Regional anesthesia is increasingly recognized as a valuable asset in contemporary pain management practices. Widely acknowledged for its safety and efficacy, regional anesthesia is frequently utilized across diverse surgical interventions. Particularly, it is the preferred anesthetic modality for surgeries involving the forearm [4]. Notably, regional anesthesia not only ensures intraoperative analgesia but also offers prolonged pain relief during the postoperative phase, minimizing systemic side effects through the judicious use of anesthetic agents [5].

Among the various techniques, brachial plexus block stands out as a well-established method for upper limb surgical procedures [6]. William

Halsted (1852-1922) pioneered the first application of brachial plexus block, employing cocaine via a surgical approach [7,8]. Given the extensive sensory and motor innervation provided by the brachial plexus to the upper limb, a single injection around this nerve complex can achieve anesthesia spanning from the shoulder to the fingertips.

Among the various techniques, brachial plexus block stands out as a well-established method for upper limb surgical procedures [6]. William Halsted (1852-1922) pioneered the first application of brachial plexus block, employing cocaine via a surgical approach. Given the extensive sensory and motor innervation provided by the brachial plexus to the upper limb, a single injection around this nerve complex can achieve anesthesia spanning from the shoulder to the fingertips [9].

Brachial plexus block serves as a widely employed technique for upper limb surgeries, offering an alternative to general anesthesia. This regional anesthesia method presents several advantages over general anesthesia, including the avoidance of potential complications such as airway trauma and the stress response associated with laryngoscopy and tracheal intubation, thereby reducing the administration of multiple drugs and shortening recovery time. Furthermore, it circumvents discomforting side effects like nausea, vomiting, hangover, and sore throat typically experienced post-general anesthesia. Employing minimal anesthetic drugs helps mitigate the stress response, particularly in patients with comorbidities such as cardiorespiratory diseases. Notably, brachial plexus block proves to be cost-effective while providing effective postoperative analgesia[10]. Additionally, it reduces the need for perioperative opioid administration.

Material and Methods

Department of Anesthesiology, Amaltas Institute of Medical Sciences, Dewas, M.P. The study encompassed 80 eligible patients undergoing upper limb surgeries who met the criteria of inclusion and exclusion. The investigator provided comprehensive information in the participants'

native language regarding the study's goals and objectives. Additionally, written informed consent was obtained from all participants prior to their inclusion in the study.

Patients meeting the predefined inclusion and exclusion criteria were enrolled in the study following approval from the Institutional Ethics Committee. The investigator communicated the study's aim and objectives comprehensively in the participants' native language, and their informed consent was obtained before their involvement.

All 80 patients satisfying the inclusion and exclusion criteria were randomly allocated into two groups, Group A and Group B, using slips in the box technique:

Group A: Receiving 30 ml of 0.5% ropivacaine and 100 mcg of fentanyl(2ml)

Group B: Receiving 30 ml of 0.5% ropivacaine and 150 mcg of clonidine (1ml) with 1ml NS

Inclusion Criteria

- 18 – 50 years of either sex.
- Patient undergoing upper limb surgeries.
- ASA physical status I and II.
- Fully informed and consented to participate.

Exclusion Criteria

- Refusal of patient for being a part of the study.
- Patients not willing to give written informed consent.
- Patients with co-morbid condition like diabetes mellitus, asthma, hypertension, cardiac disease, haematological disease, epilepsy etc.
- Patients with allergy to fentanyl or clonidine or ropivacaine.
- Patients belonging to ASA class III and above.
- Patients with local site infection.

Result

Table 1: Comparison between Two Groups According to Age

	Group				P value
	Ropivacaine +fentanyl		Ropivacaine +clonidine +NS		
Age Group(year)	N	%	N	%	
<20 year	2	5.00%	1	2.50%	0.9309
21-30 year	4	10.00%	5	12.50%	
31-40 year	14	35.00%	14	35.00%	
41-50 year	20	50.00%	20	50.00%	
All	40	100.00%	40	100.00%	
Mean Age	39.97±8.15		39.65±7.75		0.8555

The age distribution between the two groups, Ropivacaine + Fentanyl and Ropivacaine + Clonidine + NS, is summarized in Table 1. The comparison of specific age groups and their respective percentages within each group reveals no significant differences.

In the Ropivacaine + Fentanyl group, 5.00% (n=2) were less than 20 years old, 10.00% (n=4) were aged 21-30 years, 35.00% (n=14) were aged 31-40 years, and 50.00% (n=20) were aged 41-50 years. In the Ropivacaine + Clonidine + NS group, 2.50%

(n=1) were less than 20 years old, 12.50% (n=5) were aged 21-30 years, 35.00% (n=14) were aged 31-40 years, and 50.00% (n=20) were aged 41-50 years.

The mean age for the Ropivacaine + Fentanyl group was 39.97 years (SD = 8.15), while the mean age for the Ropivacaine + Clonidine + NS group was 39.65 years (SD = 7.75). P-values 0.9309 and 0.8555, for age groups and mean age indicating no significant difference.

Table 2: Comparison between two groups according to ASA Grade

ASA Grade	Group				P value
	Ropivacaine +fentanyl		Ropivacaine +clonidine+NS		
	N	%	N	%	
I	17	42.50%	23	57.50%	0.1825
II	23	57.50%	17	42.50%	
All	40	100.00%	40	100.00%	

The ASA Grade distribution between the two groups, Ropivacaine + Fentanyl and Ropivacaine + Clonidine + NS. In the Ropivacaine + Fentanyl group, 42.50% (n=17) of patients were classified as ASA Grade I, while 57.50% (n=23) were classified as ASA Grade II. Conversely, in the Ropivacaine + Clonidine + NS group, 57.50% (n=23) of patients

were classified as ASA Grade I, and 42.50% (n=17) were classified as ASA Grade II. The P-value for the comparison of ASA Grade distribution between the groups was 0.1825, indicating no significant difference in ASA Grade distribution between the two groups.

Table 3: Comparison between Two Groups According to SurgeryTime (Min.)

Variable	Ropivacaine +fentanyl	Ropivacaine+clonidine +NS	P value
	Mean ± SD	Mean ± SD	
Surgery Time(Min.)	86.75 ± 22.70	85.80 ± 20.10	0.8434

The mean surgery times between the Ropivacaine +Fentanyl group and the Ropivacaine + Clonidine + NS group. The mean surgery time was 86.75 minutes ± 22.70 (SD) in the Ropivacaine + Fentanyl group and 85.80 minutes ± 20.10 (SD) in

the Ropivacaine + Clonidine + NS group. The P-value comparing surgery times between the groups was 0.8434, indicating no statistically significant difference in surgery duration between the two groups.

Table 4: Comparison between Two Groups According toComplication of Nausea Among Patients

Nausea	Group				P value
	Ropivacaine +fentanyl		Ropivacaine +clonidine+NS		
	N	%	N	%	
No	36	90.00%	36	90.00%	1.0000
Yes	4	10.00%	4	10.00%	
All	40	100.00%	40	100.00%	

Compares the incidence of nausea complications between the two groups. In both the Ropivacaine + Fentanyl and Ropivacaine + Clonidine + NS groups, 90.00% of patients did not experience nausea, while 10.00% did. The P-value was 1.0000, indicating no statistically significant difference in the incidence of nausea between the two groups.

Table 5: Comparison Between Two Groups According to Onsetof Sensory & Motor Block (minutes) and Duration of Sensory &Motor Block (minutes) of Study Population

Variable	Ropivacaine +fentanyl	Ropivacaine+clonidine +NS	P-value
	Mean ± SD	Mean ± SD	
Onset of SensoryBlock (minutes)	11.78 ± 2.51	13.07 ± 2.46	0.0227
Onset of MotorBlock (minutes)	14.75 ± 2.53	16.19 ± 2.32	0.0095
Duration of MotorBlock (minutes)	417.43 ± 68.55	481.08 ± 66.76	0.0001
uration of SensoryBlock (minutes)	460.60 ± 66.10	529.10 ± 69.54	<0.0001

Compares the onset and duration of sensory and motor blocks between the two groups. The results are summarized as follows:

Onset of Sensory Block: The mean onset of sensory block was 11.78 ± 2.51 minutes for the Ropivacaine + Fentanyl group and 13.07 ± 2.46 minutes for the Ropivacaine + Clonidine + NS group, with a P-value of 0.0227. This indicates a statistically significant difference, with the Ropivacaine + Fentanyl group achieving a faster onset of sensory block.

Onset of Motor Block: The mean onset of motor block was 14.75 ± 2.53 minutes for the Ropivacaine + Fentanyl group and 16.19 ± 2.32 minutes for the Ropivacaine + Clonidine + NS group, with a P-value of 0.0095. This shows a statistically significant difference, with the Ropivacaine + Fentanyl group achieving a faster onset of motor block.

Duration of Motor Block: The mean duration of motor block was 417.43 ± 68.55 minutes for the Ropivacaine + Fentanyl group and 481.08 ± 66.76 minutes for the Ropivacaine + Clonidine + NS group, with a P-value of 0.0001. This indicates a statistically significant difference, with the Ropivacaine + Clonidine + NS group having a longer duration of motor block.

Duration of Sensory Block: The mean duration of sensory block was 460.60 ± 66.10 minutes for the Ropivacaine + Fentanyl group and 529.10 ± 69.54 minutes for the Ropivacaine + Clonidine + NS group, with a P-value of <0.0001 . This shows a statistically significant difference, with the Ropivacaine + Clonidine + NS group having a longer duration of sensory block.

These results demonstrate that while the Ropivacaine + Fentanyl group achieved faster onsets of both sensory and motor blocks, the Ropivacaine + Clonidine + NS group had significantly longer durations of both sensory and motor blocks.

Discussion

Anesthesiologists frequently employ peripheral nerve blocks either in place of or in conjunction with general anesthesia, as well as for postoperative pain management across a broad spectrum of surgical procedures. The choice of an optimal long-acting local anesthetic and its concentration for supraclavicular brachial plexus blocks has been a subject of ongoing debate [11].

Ropivacaine, an amino amide local anesthetic, is preferred due to its lower lipid solubility and reduced potential for central nervous system and cardiovascular toxicity, making it a safer choice. Adjuvants like clonidine, an α_2 -agonist, are

commonly used to enhance the effects of local anesthetics. Clonidine prolongs postoperative analgesia, exhibits sedative properties, and provides sympatholytic effects]. Conversely, fentanyl, a potent opioid agonist, offers rapid pain relief but is associated with side effects such as nausea, vomiting, pruritus, and respiratory depression, which limit its use [12].

Kathuria et al. [13] found that adding dexmedetomidine ($50 \mu\text{g}$) to 30 ml of 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus blocks resulted in a quicker onset and longer duration of sensory block compared to ropivacaine alone. In contrast, Farooq et al. [59] concluded that fentanyl (1 mcg/kg) added to 0.75% ropivacaine was more effective than dexmedetomidine (1 mcg/kg) in the onset and duration of sensory block.

Our study noted that clonidine, when added to ropivacaine, prolongs the duration of sensory blockade compared to fentanyl, consistent with other studies [14]. Kanvee et al. found that dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block for upper limb surgery was superior to clonidine, as it resulted in a longer duration of motor blockade without significant adverse effects. Balasubramanyam [15], concluded that dexmedetomidine (1 mcg/kg) as an adjuvant led to an earlier onset and prolonged duration of motor blockade with better block quality compared to clonidine (1 mcg/kg) when added to ropivacaine. Dharmarao and Holyachi, observed that dexmedetomidine prolongs the duration of motor block compared to fentanyl, although the onset of motor blockade was not statistically significant between the two groups.

Marhofer et al. [16] added dexmedetomidine to ropivacaine in a USG-guided ulnar nerve block, demonstrating decreased time for the onset of motor block without affecting the onset of sensory block, while prolonging the duration of both sensory and motor blocks.

Yoshitomi et al. [17] studied alpha-2 adrenoceptor agonists, including dexmedetomidine, clonidine, and oxymetazoline, combined with lidocaine in male guinea pigs, finding that adrenoceptor agonists enhance the degree of local anesthesia of lidocaine in a dose-dependent manner. Rancourt et al. conducted a prospective, randomized, controlled, double-blind, crossover trial in 14 healthy volunteers who received a USG-guided tibial nerve block, concluding that dexmedetomidine added to ropivacaine prolongs the duration of sensory blockade.

Conclusion

The findings of this study suggest that both clonidine and fentanyl, when added to 0.5% ropivacaine for supraclavicular brachial plexus blocks, enhance the efficacy of the block, but with distinct differences. Fentanyl significantly shortened the onset of both sensory and motor block but clonidine prolonged the both duration of sensory and motor block compared to fentanyl. This aligns with existing literature, which also supports the superior efficacy of clonidine as well as dexmedetomidine as adjuvants in prolonging block duration and enhancing analgesic effects.

References

- Ashfi S, Haque A, Kumar M, Lakra L. A comparative study of intrathecal hyperbaric bupivacaine 0.5% with morphine and dexmedetomidine in lower limb orthopedic surgeries: A double-blind randomized clinical trial. *Anesth Essays Res.* 2022;16(3):373. doi:10.4103/aer.aer_116_22
- Tiwari S, Dwivedi R, Dwivedi S. Comparative Evaluation Of 0.25% Bupivacaine And 0.25% Ropivacaine in Transversus Abdominis Plane Block for Postoperative Analgesia after Inguinal Hernia Surgery. *Int J Sci Res.* 2019; 8(12): 48-50. doi:10.36106/ijsr
- Raja SN, Carr DB, Cohen M, et al. The Revised IASP definition of pain: concepts, challenges, and compromises HHS Public Access. *Pain.* 2020;161(9):1976-1982.
- Kuriyama A, Maeda H. Preoperative intravenous dexamethasone prevents tracheal intubation-related sore throat in adult surgical patients: a systematic review and meta-analysis. *Can J Anesth.* 2019;66(5):562-575. doi:10.1007/s12630-018-01288-2
- Das A, Majumdar S, Halder S, et al. Effect of dexmedetomidine as adjuvant in ropivacaine-induced supraclavicular brachial plexus block: A prospective, double-blinded and randomized controlled study. *Saudi J Anaesth.* 2014; 8(Suppl 1):S72-7. doi:10.4103/1658-354X.144082
- Raju PKBC, Coventry DM. Ultrasound-guided brachial plexus blocks. *Contin Educ Anaesth Crit Care Pain.* 2014;14(4):185- 191. doi:10.1093/bjaceaccp/mkt059
- Halsted WS. Practical comments on the use and abuse of cocaine; suggested by its invariably successful employment in more than a thousand minor surgical operations. *Surv Anesthesiol.* 1984;28(2):156. doi:10.1097/00132586-198404000-00072
- Crile G. Anesthesia of nerve roots with cocaine. *Clevel Med J.* 1897; 2:355.
- Pester JM, Varacallo M. *Brachial Plexus Block Techniques.*; 2019. <http://www.ncbi.nlm.nih.gov/pubmed/29262036>
- 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;52(9):858-862. doi:10.1111/j.1365-2044.1997.174-az0311.x
- Kathuria S, Gupta S, Dhawan I. Dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block. *Saudi J Anaesth.* 2015;9(2):148-154. doi:10.4103/1658-354X.152841
- Kanvee V, Patel K, Doshi M, Mayur V, Kapil G. Comparative Study of Clonidine and Dexmedetomidine as an Adjuvant with Ropivacaine in Supraclavicular Brachial Plexus Block for Upper Limb Surgery. *J Res Med Dent Sci.* 2015;3(2):127. doi:10.5455/jrmds.2015327
- Balasubramanyam V, K.N SS, Jamuna T. A Comparative Evaluation Of 0.75% Ropivacaine with Clonidine And 0.75% Ropivacaine with Dexmedetomidine In Supraclavicular Brachial Plexus Block- A Prospective Randomised Double-Blind Study. *J Evid Based Med Healthc.* 2018;5(2):101-106. doi:10.18410/jebmh/2018 /23
- Dharmarao PS, Holyachi R. Comparative study of the efficacy of dexmedetomidine and fentanyl as adjuvants to ropivacaine in ultrasound-guided supraclavicular brachial plexus block. *Turk Anesteziyoloji Reanimasyon Dern Derg.* 2018;46(3):208-213. doi: 10.5152/TJAR.2018.98058
- Marhofer D, Kettner SC, Marhofer P, Pils S, Weber M, Zeitlinger M. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: A volunteer study. *Br J Anaesth.* 2013;110(3): 438-442. doi:10.1093/bja/aes400
- Yoshitomi T, Kohjitani A, Maeda S, Higuchi H, Shimada M, Miyawaki T. Dexmedetomidine enhances the local anesthetic action of lidocaine via an α -2a adrenoceptor. *Anesth Analg.* 2008;107(1):96-101. doi:10.1213/ane.0b013e318176be73
- Rancourt MPM, Albert NT, Côté M, Létourneau DR, Bernard PM. Posterior Tibial Nerve Sensory Blockade Duration Prolonged by Adding Dexmedetomidine to Ropivacaine. *Surv Anesthesiol.* 2013;57(4):201-202. doi:10.1097/01.sa.0000431233.31286.19