Open Access

ORIGINAL ARTICLE

Comparison of Outcomes of Intravenous Dexamethasone Versus Placebo as Adjunct to Local Anaesthetic Brachial Plexus Block for Upper Limb Surgery

Naila Mughal[1], Ammar Shah[2], Sana Latif[3], Umer Naseem[4], Farah Naz[5], Muhammad Nazir Awan[6]

[1]Medicare Hospital, [2]Rawalpindi Medical University, Rawalpindi, [3]College of Physicians and Surgeons of Pakistan, Karachi, 4Social Security Hospital, Gujrat, [5]Al Suffah Hospital, Rawalpindi, [6]Ripha University, Islamic International Medical University, Islamabad

ABSTRACT

Objective: To compare the outcomes of intravenous dexamethasone versus placebo as adjunct to local anesthetic brachial plexus block for upper limb surgery.

Methodology: A total of 100 patients of either gender aged 18 to 60 years admitted for upper limb surgery were included. Patients with pregnancy, Diabetes mellitus, block failure and contraindication to brachial plexus block were excluded. Patients in group A received a block injection with 30ml of 0.5% bupivacaine along with 2ml of intravenous dexamethasone. Group B patients received 30ml of 0.5% bupivacaine for block injection and 2ml of normal saline intravenously. Block success was confirmed using the sensory and motor examination of the upper limb. Block duration was recorded in hours, opioid consumption was recorded in intravenous morphine equivalents in first 24 hours, visual analogue scores for pain on scale of 0-10 at upper limb at rest was recorded at 8 and 24 hours. The study was conducted in Department of Anesthesia, pain management and intensive care Holy Family Hospital, Rawalpindi during 7th November 2019 till 6th May 2020.

Results: In our study, duration of local anesthetic brachial plexus block in dexamethasone and placebo group were 16.12 ± 1.33 hrs and 9.77 ± 1.26 hrs respectively with p-value = 0.0001. Opioid consumption in Morphine Equivalents at 24 hrs in local anesthetic brachial plexus block and placebo group were 16.48 ± 2.60 vs 22.68 ± 3.78 respectively with p-value < 0.0001.

Conclusion: Intravenous dexamethasone has better outcomes as compared to intravenous saline as adjunct to local anesthetic brachial plexus block for upper limb surgery.

Keywords: Brachial plexus block, Intravenous dexamethasone, Anesthetic block

Authors' Contribution:
[1,2]Conception; Literature research; [3]manuscript design and drafting; [4,5]Critical analysis and manuscript review; [6]Data analysis; Manuscript Editing.

Correspondence:
Ammar Shah
Email: ammarali05@gmail.com

Article info:
Received: January 22, 2024
Accepted: March 01, 2024

Cite this article. Mughal N, Shah A, Latif S, Naseem U, Naz F, Awan MN. Comparison of Outcomes of Intravenous Dexamethasone Versus Placebo as Adjunct to Local Anesthetic Brachial Plexus Block for Upper Limb Surgery. J Islamabad Med Dental Coll. 2024; 13(2): 217 223.
DOI: https://doi.org/10.35787/jimdc.v13i2.1109

Funding Source: Nil
Conflict of interest: Nil

Introduction

Traditionally, general anaesthesia has been used for surgeries on the upper limb. However, this has its own drawbacks, including airway instrumentation, exposure to several medications, and potential for aspiration in the case of insufficient nil oral status.[1] Because of its improved effectiveness, higher margin of safety, lower total cost, shorter hospital stays, avoidance of unfavourable side effects of general anaesthetic, and efficient postoperative analgesia, brachial plexus block has become an effective tool in the anesthesiologist's apparatus. Kulenkampff first described the supraclavicular brachial plexus block

in 1911.[2] It is a well-liked and frequently applied procedure for perioperative anaesthesia and analgesia for surgery of upper limb, except for shoulder surgery.[3] Brachial plexus (C5-T1) innervates almost all upper extremity dermatomes and all osteotomes. Anesthesia and analgesia for elbow and hand procedures targets the brachial plexus distal to roots/trunks. Supra- and infraclavicular approaches anesthetize trunks/divisions and cords of plexus, respectively.[4] Optimal pain management is of prime importance in all types of surgeries especially orthopedics to ensure early rehabilitation and physiotherapy.[1] Post-operative pain management in upper limb surgery can be tricky and failure to do so will result in increased morbidity.[2] Use of brachial plexus block has a proven efficacy record and helps bring down the use of opioids and their associated draw backs[3.] Using ultrasound to locate the nerves for the block placement decreases the time required and brings down the complication rate of the procedure. Local anesthetics have been tried and tested in combination with various other drugs to enhance their effectiveness with inconsistent results.[4]Dexamethasone has been tested in combination with different local anesthetics with varying results including increase in intensity and duration of block.[5] Other benefits include improved Visual Analogue scores for pain, decreased use of other analgesics and nausea and vomiting.

Two systemic reviews and meta-analysis recently published in international journals have demonstrated the effectiveness of perineural dexamethasone.[6] However, there is a concern with respect to potential neurotoxicity of dexamethasone and therefore it is not a licensed for perineural route of administration. Another meta-analysis and systematic review reported in 2017 conclude that intravenous and perineural dexamethasone have a similar effect on block duration, post-operative analgesia, opioid consumption, nausea and vomiting.[7]

In a study done by Rosenfeld et al. mean standard deviation of block duration was 18.2 ± 6.4 and 13.8 ± 3.8, opioid consumption was 17.1 ±15.9 and 24.1 ± 14.3 and pain score at 24 hours was 3±0.5 and 2.5±0.5 among intravenous dexamethasone and saline, respectively.[8] We planned the study to find out the optimal role of dexamethasone on the duration of block, post-operative pain and opioid consumption via intravenous route in cases where regional anesthesia with local anesthetics is effective without risk of neurotoxicity.

Methodology

This study was a randomized controlled trial, conducted at Department of Anaesthesia, Pain Management and Intensive Care, Holy Family Hospital, Rawalpindi, between November 7th 2019 till 6th May 2020. Consecutive non probability sampling was done. Sample size was calculated using the WHO calculator keeping the level of significance as 5%, power of the test as 80%, population mean ± standard deviation in intervention group 17±15.9, population mean ± SD in control group 24 ±14.3 and population size (n) was 50 in each group, a total of 100 participants. In our study we calculated block duration from the time of injection till the complete resolution of sensory block. While the block was deemed successful by inability to abduct the shoulders and profound numbness. Post-operative pain was assessed using the visual analogue scale during the first 24 hours. In order to gauge post-operative pain opioid consumption was used as standard intravenous morphine equivalents.

Inclusion and exclusion criteria:

In this study we concluded 18 to 60 years who were planned to go elective surgery on the upper limb. These patients were ASA standard 1 and 2. Patients having any contraindication to brachial plexus clock or had block failure were excluded. Patient taking greater than 60mg of oral morphine equivalents per day. Pregnant ladies, diabetes mellitus or patient having any allergies. After approval from hospital ethical committee, written informed

consent was taken from all patients, 100 patients were recruited according to above mentioned selection criteria. Patients were randomized into two groups through consecutive non probability sampling technique. Pre-operative assessment was done for all patients. Fasting of 6 hours for solids, 4 hours for liquids and 2 hours for clear fluids were advised. After randomization, all patients arrived for same day surgery and received a pre-operative ultrasound guided supraclavicular block using a 5-7.5 -10 MHz 60mm linear array transducer (USG machine name) performed by anesthetic team. Sedation for block insertion was achieved by using intravenous midazolam 0.03mg/kg. Data collection was done by the means of proforma with assistance from nursing staff. Post-operative pain management included 15mg of ketorolac QID and 500mg of paracetamol TDS intravenously. Block duration was recorded in hours, opioid consumption was recorded in intravenous morphine equivalents in first 24 hours, visual analogue scores for pain on scale of 0-10 at upper limb at rest was recorded at 8, 12, 16, 20 and 24 hours. Statistical analysis was performed using IBM SPSS version 20. Descriptive statistics were recorded for qualitative and quantitative variables. Qualitative variables like gender *and ASA class were measured as frequency and percentage. Quantitative variables like age, duration of surgery, duration of block, opioid consumption and pain was measured as mean±SD. Data was stratified for age, gender, BMI, duration of surgery, and post-stratification independent sample t-test was applied. To compare quantitative variables between 2 groups independent sample t test was applied. P value ≤0.05 was considered significant.

Results

Age range in this study was from 18 to 60 years with mean age of 43.21 ± 9.35 years. The mean age of patients in group A was 42.76 ± 9.26 years and in group B was 43.18 ± 9.55 years. Majority of the patients 54 (54.0%) were between 41 to 60 years of age. Out of these 100 patients, 59 (59.0%) were male and 41 (41.0%) were females with male to female ratio of ratio of 1.4:1. The mean BMI in group A was 25.80 ± 2.16 kg/m^2 and in group B was 25.94 ± 2.36 kg/m^2. The mean duration of surgery in group A was 61.87 ± 13.55 min and in group B was 66.53 ± 13.28 min. In this study, duration of block in local anesthetic brachial plexus block and placebo group were 16.12 ± 1.33 hrs and 9.77 ± 1.26 hrs respectively with p-value = 0.0001. Opioid consumption in Morphine Equivalents and VAS score at 24 hrs in local anesthetic brachial plexus block and placebo group were 16.48 ± 2.60 vs 22.68 ± 3.78 and 2.10 ± 0.81 vs 4.46 ± 0.91 with p-value < 0.0001 respectively Table I

Table I: Comparison of the Outcomes of Local Brachial Places in Block Groups

	Group A (n=50)	**Group B (n=50)**	**P value**
Duration of block (hrs)	16.12 ± 1.33	9.77 ± 1.26	**0.0001**
Opioid consumption in Morphine Equivalents	16.48 ± 2.60	22.68 ± 3.78	**0.0001**
VAS score at 8 hrs	1.50 ± 0.64	3.96 ± 0.90	**0.0001**
VAS score at 12 hrs	1.72 ± 0.70	4.16 ± 0.91	**0.0001**
VAS score at 16 hrs	1.94 ± 0.74	4.40 ± 1.01	**0.0001**
VAS score at 20 hrs	2.04 ± 0.80	4.42 ± 0.92	**0.0001**
VAS score at 24 hrs	2.10 ± 0.81	4.46 ± 0.91	**0.0001**

Table II: Stratification of Duration of Block with Respect to Age, Gender, BMI and Duration of Surgery						
		Group A (n=50)		Group B (n=50)		P-value
		Duration of block		Duration of block		
		Mean	SD	Mean	SD	
Age (years)	**18-40**	16.33	1.16	9.61	1.17	**0.0001**
	41-60	15.92	1.46	9.89	1.34	**0.0001**
Gender	**Male**	16.21	1.42	9.90	1.32	**0.0001**
	Female	16.0	1.22	9.58	1.18	**0.0001**
BMI (kg/m^2)	**≤27**	16.21	1.23	9.74	1.21	**0.0001**
	>27	15.82	1.66	9.85	1.46	**0.0001**
Duration of surgery (min)	**≤60**	15.84	1.42	9.64	1.28	**0.0001**
	>60	16.29	1.27	9.84	1.27	**0.0001**

Table III: Stratification of Opioid Consumption in Morphine Equivalents with Respect to Age.						
		Group A (n=50)		Group B (n=50)		P-value
		Opioid consumption in Morphine Equivalents		Opioid consumption in Morphine Equivalents		
		Mean	SD	Mean	SD	
Age (years)	**30-45**	16.92	2.12	24.09	3.22	**0.0001**
	46-60	16.08	2.95	21.57	3.80	**0.0001**

Discussion

The brachial plexus block using the supraclavicular technique, has become more common for upper limb procedures below the shoulder joint. Analgesia is provided for 4–8 hours by local anaesthetics administered alone in supraclavicular block[9]. Drugs such as morphine, tramadol, clonidine, butorphanol,3. dexmedetomidine, midazolam, and ketamine[10,12] used as adjuvants prolong postoperative analgesia. They were associated with side effects such as sedation, nausea, bradycardia, hypotension, and psychosomatic effects.

In this study, duration of block in local anesthetic brachial plexus block and placebo group were 16.12 ± 1.33 hrs. and 9.77 ± 1.26 hrs. respectively with p-

value = 0.0001. Opioid consumption in Morphine Equivalents and VAS score at 24 hrs in local anesthetic brachial plexus block and placebo group were 16.48 ± 2.60 vs 22.68 ± 3.78 and 2.10 ± 0.81 vs 4.46 ± 0.91 with p-value <0.0001 respectively.

Shrestha et al., Pathak et al used 8 mg dexamethasone as an adjuvant in block.[9-10] and almost similar results were achieved using dexamethasone in dose of 0.05 mg/kg and 0.02 mg/kg. Persec et al. evaluated low-dose dexamethasone in conjugation with plain levobupivacaine for brachial plexus blockade at supraclavicular level with almost same duration of analgesia as other studies.[11]

In contrast to our findings Shrestha et al.,[9] Islam et al.[12] found that the addition of dexamethasone leads to early onset of sensory and motor blockade. Similar findings were seen in study by Biradar et al.[13] Pathak et al.[10] Persec et al.,[11] Islam et al.[12] and Biradar et al.[13] also had similar observations that group where steroid was used as an adjuvant had prolonged postoperative analgesia. Our study results showing the duration of analgesia for B group (15.8 ± 2.6) were comparable to the meta-analysis done by Choi et al.[14] where from nine trials 801 patients were included. Dexamethasone, according to their findings, increased the analgesic duration of long-acting local anaesthetics from 730 to 1306 min (mean difference = 576 min).

Jadon et al[15] performed a study on 112 patients undergoing arthroscopic shoulder surgery under interscalene block. In the ropivacaine group, patients received 30 ml of 0.5% ropivacaine combined with 2 ml of normal saline, while in the dexamethasone-ropivacaine group, they received 30 ml of 0.5% ropivacaine along with 8 mg of dexamethasone. They discovered that VAS values in the first 4 hours were comparable, but at the end of 8 hours, 12 hours, 16 hours, 20 hours, and 24 hours, VAS scores in the ropivacaine group were significantly higher.

Patients in the dexamethasone-ropivacaine group had significantly lower VAS scores (2.5-3.3) compared to the ropivacaine group (4.2-5.06) and had excellent pain control up to 24 hours after the procedure (P<0.05).

Likewise, Tandoc and colleagues[16] evaluated 90 patients undergoing shoulder surgery using interscalene block with 0.5% bupivacaine (40 ml) and divided them into 3 groups: control patients, with no additive, and two dexamethasone groups, to whom 4 mg and 8 mg dexamethasone were added. The duration of analgesia was significantly prolonged in both dexamethasone groups (21.6 h and 25.2 h, respectively) compared with the control group (13.3 h). Postoperative analgesic consumption for the first 48 hours was significantly lower in both dexamethasone groups compared to the control group.

Cummings and colleagues[17] conducted a significant double-blinded study using a single-injection interscalene block for shoulder surgeries, in which 218 patients were divided into four groups. The groups were each given 30 ml of either 0.5% ropivacaine or 0.5% bupivacaine mixed with 8 mg of dexamethasone, and compared with a placebo group. They came to the conclusion that dexamethasone greatly increased the analgesic duration of ropivacaine by 1.9 times and bupivacaine by 1.5 times. Dexamethasone's impact was markedly greater with ropivacaine than with bupivacaine.

In contrast to our research, Jaeger et al.[18] conducted a paired, blinded, randomized trial that included healthy men. The saphenous nerve was bilaterally blocked in all individuals using ropivacaine 0.5%, 20 ml combined with dexamethasone 2 mg in one leg and saline in the other. They discovered that block duration measured by temperature discrimination was not statistically significantly longer in the leg receiving dexamethasone and came to the conclusion that perineural administration of dexamethasone 2 mg had a limited and inconsistent effect on block duration. The smaller dose of dexamethasone applied to the ropivacaine may have contributed to their findings. Additionally,

Noori and his colleagues[19], examined 49 patients undergoing foot and ankle surgery to investigate the effects of adding 8 mg of dexamethasone to popliteal nerve blocks. Their findings showed that there was no statistically significant difference in the length of analgesia between the 2 groups.

Conclusion

Intravenous dexamethasone increases the duration of supra-clavicular block and reduces post-operative use of opioid medications. Thus, improving patient's outcome.

References

1. Song ZG, Pang SY, Wang GY, Zhang Z. Comparison of postoperative analgesic effects in response to either dexamethasone or dexmedetomidine as local anesthetic adjuvants: a systematic review and meta-analysis of randomized controlled trials. Journal of anesthesia. 2021 Apr;35:270-87. https://doi.org/10.1007/s00540-021-02895-y
2. Choi EJ, Kim DH, Han WK, Lee HJ, Kang I, Nahm FS, Lee PB. Non-particulate steroids (Betamethasone sodium phosphate, dexamethasone sodium phosphate, and dexamethasone Palmitate) combined with local anesthetics (ropivacaine, levobupivacaine, bupivacaine, and lidocaine): a potentially unsafe mixture. Journal of Pain Research. 20217:1495-504. https://doi.org/10.2147/JPR.S311573
3. Edinoff AN, Houk GM, Patil S, Siddaiah HB, Kaye AJ, Iyengar PS, Cornett EM, Imani F, Mahmoudi K, Kaye AM, Urman RD. Adjuvant drugs for peripheral nerve blocks: the role of alpha-2 agonists, dexamethasone, midazolam, and non-steroidal anti-inflammatory drugs. Anesthesiology and Pain Medicine. 2021;11(3). https://doi.org/10.5812/aapm.117197
4. Xuan C, Yan W, Wang D, Li C, Ma H, Mueller A, Wang J. The facilitatory effects of adjuvant pharmaceutics to prolong the duration of local anesthetic for peripheral nerve block: a systematic review and network meta-analysis. Anesthesia & Analgesia. 2021 Sep 1;133(3):620-9. https://doi.org/10.1213/ANE.0000000000005640
5. Elshaer AN, Said SG, Alawady DS, Reyad AM. Dexamethasone with Local Anesthetics Versus Local Anesthetics Alone in Supraclavicular Brachial Plexus Block in Upper Limb Surgeries. QJM: An International Journal of Medicine. 2020 Mar 1;113(Supplement_1):hcaa039-020. https://doi.org/10.1093/qjmed/hcaa039.020
6. Li M, Zhang P, Wei D. Efficacy of Dexamethasone versus Dexmedetomidine Combined with Local Anaesthetics in Brachial Plexus Block: A Meta-Analysis and Systematic Review. Evidence-Based Complementary and Alternative Medicine. 2022 Mar 1;2022. https://doi.org/10.1155/2022/7996754
7. Desai N, Kirkham KR, Albrecht E. Local anaesthetic adjuncts for peripheral regional anaesthesia: a narrative review. Anaesthesia. 2021 Jan;76:100-9. https://doi.org/10.1111/anae.15245
8. Rosenfeld DM, Ivancic MG, Hattrup SJ, Renfree KJ, Watkins AR, Hentz JG, et al. Perineural versus intravenous dexamethasone as adjuncts to local anaesthetic brachial plexus block for shoulder surgery. Anaesthesia. 2016;71(4):380–8. https://doi.org/10.1111/anae.13409
9. Shrestha BR, Maharjan SK, Tabedar S. Supraclavicular brachial plexus block with and without dexamethasone – A comparative study. Kathmandu Univ Med J. 2003;1:158–60.
10. Pathak RG, Anand PS, Rajendra NK. Supraclavicular brachial plexus block with and without dexamethasone – A comparative study. Int J Sci Res Publ. 2012;12:1–7. https://doi.org/10.7860/JCDR/2016/18325.8048
11. Persec J, Persec Z, Kopljar M, Zupcic M, Sakic L, Zrinjscak IK, et al. Low-dose dexamethasone with levobupivacaine improves analgesia after supraclavicular brachial plexus blockade. Int Orthop. 2014;38:101–5. https://doi.org/10.1007/s00264-013-2094-z
12. Islam SM, Hossain MH, Maruf AA. Effect of addition of dexamethasone to local anaesthetics in supraclavicular brachial plexus block. J Armed Forces Med Coll Bangladesh. 2011;7:11–4.
13. Biradar PA, Kaimar P, Gopalakrishna K. Effect of dexamethasone added to lidocaine in supraclavicular brachial plexus block: A prospective, randomised, double-blind study. Indian J Anaesth. 2013;57:180–4. https://doi.org/10.4103/0019-5049.111850

14. 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. Br J Anaesth. 2014;112:427-39. https://doi.org/10.1093/bja/aet417
15. Jadon A, Dixit S, Kedia SK, Chakraborty S, Agrawal A, Sinha N. Interscalene brachial plexus block for shoulder arthroscopic surgery: prospective randomised controlled study of effects of 0.5% ropivacaine and 0.5% ropivacaine with dexamethasone. Indian J Anaesthesia 2015;59(3):171. https://doi.org/10.4103/0019-5049.153039
16. Tandoc MN, Fan L, Kolesnikov S, Kruglov A, Nader ND. Adjuvant dexamethasone with bupivacaine prolongs the duration of interscalene block: a prospective randomized trial. J Anesthesia. 2011;25(5):704–709. https://doi.org/10.1007/s00540-011-1180-x
17. Cummings KC III, Napierkowski DE, Parra-Sanchez I, Kurz A, Dalton JE, Brems JJ, Sessler DI. Effect of dexamethasone on the duration of interscalene nerve blocks with ropivacaine or bupivacaine. Brit J Anaesthesia. 2011;107(3):446–453.
18. Jæger P, Grevstad U, Koscielniak-Nielsen ZJ, Sauter AR, Sørensen JK, Dahl JB. Does dexamethasone have a perineural mechanism of action? A paired, blinded, randomized, controlled study in healthy volunteers. Brit J Anaesthesia. 2016;117(5):635–641. https://doi.org/10.1093/bja/aew318
19. Noori N, Anand K, Pfeffer G, Thordarson D. Dexamethasone addition to popliteal nerve blocks: effects on duration of analgesia and incidence of postoperative nerve complication. Foot Ankle Spec. 2020 https://doi.org/10.1177/1938640019897224