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ORIGINAL ARTICLE

Optimizing Analgesia in Shoulder Arthroscopy: Comparison of 2 mg Vs 4 mg Perineural Dexamethasone in Interscalene Nerve Block

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Abstract

Introduction: Postoperative pain management is crucial especially among patients undergoing upper limb surgeries, since multiple systemic analgesics can cause many adverse effects. Regional anesthesia, specifically ultrasound-guided interscalene brachial plexus block serves as effective postoperative analgesia. The duration of a single dose of nerve block is limited and hence, to enhance the quality of analgesia and prolong its duration, adjuvants like dexamethasone are being added. Hence this study was planned to compare the efficacy of 2 mg perineural dexamethasone with 4 mg perineural dexamethasone among those who were planned for shoulder arthroscopy under general anesthesia. **Materials and Methods:** This study was conducted in a teritiary care hospital in south India among 56 participants who underwent arthroscopic surgery in the shoulder. They were allotted to either 2 mg or 4 mg dexamethasone groups by lottery method and with the help of Ultrasound guided interscalene block, bupivacaine was injected. A structured proforma was used to collect data (sociodemographic, clinical, duration to achieve and maintenance of sensory/motor blockade and hemodynamics). **Results:** Both groups were ensured to be comparable before the start of the study. The 4mg Dexamethasone group achieved faster motor and sensory blockade and the effect of analgesia was prolonged in the 4mg group compared to the 2 mg group . No significant adverse events was noted between groups. **Conclusion:** Analgesic effect of 4 mg dexamethasone given perineurally enhances the effectiveness of the interscalene brachial block (onset and duration of motor and sensory block) when compared to 2mg. The safety profile is also favourable. The use of 4 mg dexamethasone is considered a better adjuvant for post operative pain among those undergoing shoulder arthroscopy under regional anesthesia.

Keywords: Dexamethasone, Interscalene block, Brachial plexus block, Postoperative analgesia, Shoulder arthroscopy

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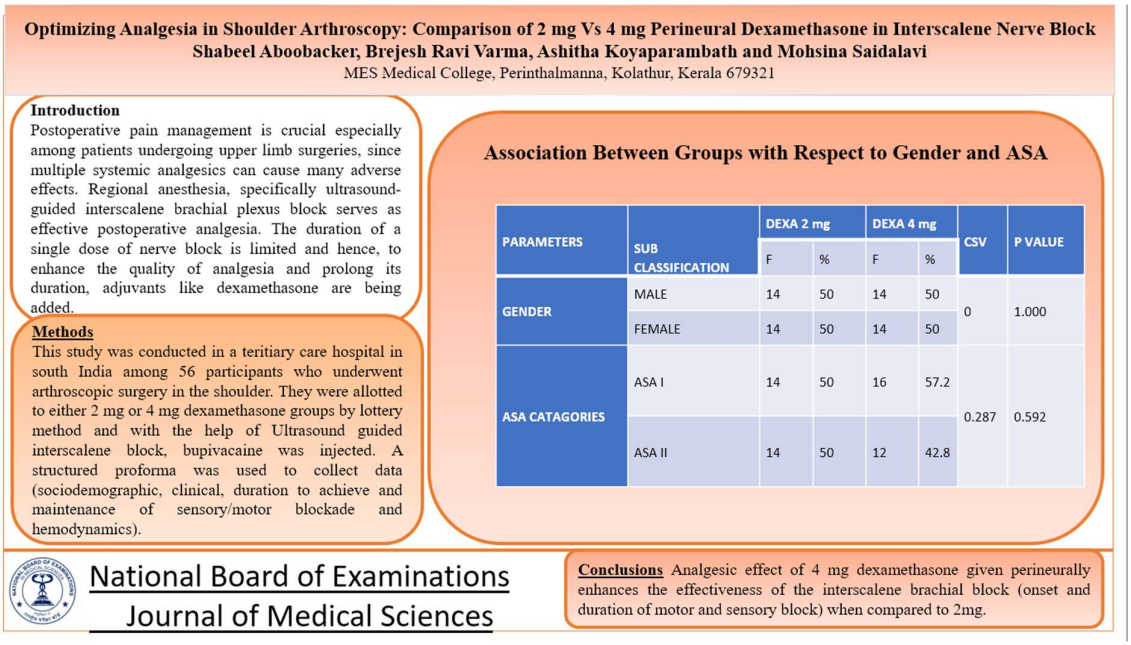
Graphical Abstract



Introduction

Postoperative pain following orthopedic surgeries, particularly shoulder procedures, can be severe and challenging to manage for both anesthesiologists and orthopedic surgeons [1]. Regional anesthesia, specifically the interscalene brachial plexus block, is commonly employed as a supplement to general anesthesia or as the primary technique to enhance analgesia and facilitate early mobilization [2].

A single perineural injection of a long-acting local anesthetic typically provides pain relief for 10–15 hours. While the placement of a perineural catheter or continuous infusion can extend analgesia, these methods carry potential drawbacks, including catheter migration, spontaneous displacement, leakage of anesthetic, and pump malfunction, leading to a 40% risk of inadequate pain control [3]. To prolong analgesic effects, the addition of an adjuvant to the local anesthetic has emerged as an alternative strategy.

Bupivacaine continues to be the most used local anesthetic. The duration of action of bupivacaine is relatively longer, lasting between 3 to 8 hours. But its its clinical utility is limited by delayed onset and inconsistent or incomplete analgesia. Various adjuvants like neostigmine, opioids, hyaluronidase, midazolam, clonidine, and Dexamethasone are being tried improve the efficacy and duration of postoperative analgesia [4].

Perineural Dexamethasone has gained immense importance as an analgesic adjunct [5], after the first clinical trial in 2003. It offers a favorable pharmacological profile with an improved risk-benefit ratio compared to other adjuvants, thereby optimising postoperative pain management [6].

Orthopedic surgeries like shoulder arthroscopy require adequate postoperative analgesia in perioperative care. While the interscalene brachial plexus block remains

a standard technique for pain management, the efficacy of local anesthetics can be influenced by the choice of adjuvants. Perineural Dexamethasone has shown promising results in enhancing the onset and prolonging the duration of sensory and motor blockade [5,6]. The optimal dose of perineural dexamethasone with maximum benefits and minimal risks is an area of ongoing research. The aim of this is to compare the effects of 2 mg versus 4 mg of perineural Dexamethasone in interscalene blocks, focusing on its impact on the onset and duration of sensory and motor blockade. The findings may provide valuable insights into refining regional anesthesia protocols for improved postoperative pain control and patient outcomes.

Materials and Methods

This observational prospective study was conducted in the Department of Anaesthesiology at MES Medical College & Hospital, Perinthalmanna. The study was done over a period of one year from January 1, 2020 to December 31, 2020. 56 participants who were posted for elective shoulder surgery were taken up for the study. Institutional Ethics Committee approval was obtained before the start of the study. All participants provided written informed consent after being explained about the study objectives, potential risks, and benefits.

The study population comprised of adults between 18 and 85 years of age who were classified as ASA Physical Status I–III and scheduled for elective shoulder arthroscopy under general anesthesia with ultrasound-guided interscalene brachial plexus block. The participants were randomly allotted to 2mg or 4 mg group using sealed envelope technique. Patients with pre-existing neurological deficits in the operative limb, contraindications to peripheral nerve block (such as local anesthetic allergy, coagulopathy, or local infection), diabetes mellitus, pregnancy, brachial plexus neuropathy, recent systemic glucocorticoid or chronic opioid or steroid use were excluded.

Patients were kept nil per oral as per ASA guidelines before surgery. Standard monitoring using electrocardiography, non-invasive blood pressure, and pulse oximetry, were done in the operating room. Baseline vitals were recorded, and an 18-gauge intravenous line was secured in the non-operative limb. Patients were positioned in a semi-recumbent posture with their head turned 45° away from the surgical side. No sedatives or analgesics were administered before the block procedure. The interscalene brachial plexus was identified using a high-frequency linear array transducer under sterile conditions. Following skin infiltration with 2% Lignocaine with Adrenaline, a 5 cm stimuplex needle was inserted using an in-plane technique until positioned between the C5 and C6 roots. Without repositioning the needle tip, 10 mL of 0.5% bupivacaine was injected incrementally under ultrasound guidance, followed by the administration of the study drug (either 2 mg or 4 mg Dexamethasone), and a further 10 mL of 0.5% bupivacaine.

After the block procedure, patients were monitored continuously. Sensory and motor blockade were assessed every 5 minutes for 30 minutes. Sensory blockade was evaluated using a pinprick test across the C4 to C8 dermatomes (0, no perception; 1, diminished perception; 2, normal perception, vs. the contralateral side)., while motor blockade was assessed

by the ability to abduct the arm and flex the forearm (0-impossible to flex or abduct the arm against gravity; 1- less force compared with the contralateral arm; 2- equal force in both arms). A successful block was defined as a complete motor blockade (score 0) within 30 minutes. Patients received intravenous midazolam (0.02 mg/kg) and glycopyrrolate (0.003 mg/kg) as premedication. General anesthesia was induced with fentanyl (1–2 μg/kg) and propofol (2.5 mg/kg), followed by vecuronium (0.08 mg/kg) for neuromuscular blockade. Tracheal intubation was performed three minutes later, and anesthesia was maintained with titrated doses of propofol (100 μg/kg/min), atracurium (0.1 mg/kg), and a 1:1 mixture of nitrous oxide and oxygen. At the end of surgery, patients were reversed with neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg).

Postoperatively, patients were monitored in the recovery room. The duration of sensory blockade was recorded as the time from injection to the first request for analgesia, while the duration of motor blockade was determined as the time from injection to the return of normal muscle strength. Statistical analysis was performed using SPSS 22.0, with significance set at $p<0.05$. Data normality was assessed using the Shapiro-Wilk test. Group comparisons were conducted using an independent t-test for continuous variables and a chi-square test for categorical data.

Results

This cross sectional comparative study was done among 56 study participants randomly alloted into 28 in each group. The distribution of gender (male and female) is equal between the Dexa 2 mg and Dexa 4 mg groups, with no significant difference between the groups ($p = 1.000$). Similarly, the distribution of ASA categories (ASA I and ASA II) is comparable between the two groups, with no statistically significant difference ($p = 0.592$) (Table 1).

Table 1. Association between Groups with Respect to Gender and ASA

PARAMETERS	SUB CLASSIFICATION	DEXA 2 mg		DEXA 4 mg		CSV	P VALUE
		F	%	F	%		
GENDER	MALE	14	50	14	50	0	1.000
	FEMALE	14	50	14	50		
ASA CATAGORIES	ASA I	14	50	16	57.2	0.287	0.592
	ASA II	14	50	12	42.8		

There were no statistically significant differences between the Dexa 2 mg and Dexa 4 mg groups with respect to age, weight, height, BMI, heart rate, systolic blood pressure, diastolic blood pressure, or SpO_2 levels ($p > 0.05$ for all). This indicates that the baseline characteristics and hemodynamic parameters were similar in both groups before intervention, ensuring comparability and that any differences observed later are likely due to the difference in Dexamethasone dosage rather than baseline variability (Table 2).

Table 2. Comparison of Mean Hemodynamic Parameters Between Both Groups

PARAMETERS	DEXA 2 mg		DEXA 4 mg		MD	t Value	P Value
	M	SD	M	SD			
AGE	49.23	15.2	45.71	15.5	3.5	0.859	0.390
WEIGHT	65.42	7.41	64.67	7.72	0.8	0.371	0.720
HEIGHT	165.2	7.73	164.4	6.78	0.9	0.443	0.650
VMI	23.93	1.96	23.92	1.82	0	0.02	0.980
HEART RATE	77.14	7.92	76.78	6.75	0.4	0.183	0.850
SYSTOLIC BLOOD PRESSURE	137.4	9.94	134.4	12	3	1.011	0.300
DIASTOLIC BLOOD PREASSURE	79.78	9.27	75.85	8.36	3.9	1.666	0.100
SpO2	98.1	0.99	98.46	0.88	0.4	-1.438	0.150

The onset of both sensory and motor blockade was significantly faster in the Dexa 4 mg group compared to the Dexa 2 mg group ($p = 0.0001$ for both). Additionally, the duration of both sensory and motor blockade was significantly longer in the Dexa 4 mg group ($p = 0.0001$ for both). This indicates that a higher dose of Dexamethasone (4 mg) results in a faster onset and prolonged duration of both sensory and motor blockade compared to the lower dose (2 mg), demonstrating a dose-dependent enhancement of block characteristics (Table 3).

Table 3. Comparison of Onset and Duration of Blockade Between Both Groups

PARAMETERS	SUB CLASSIFICATION	DEXA 2 mg		DEXA 4 mg		MD	t Value	P Value
		M	SD	M	SD			
ONSET BLOCKADE	SENSORY BLOCKADE	4.92	0.93	3.35	1.02	1.57	6.019	0.0001
	MOTOR BLOKADE	6.39	0.83	5.14	1.01	1.25	5.06	0.0001
DURATION OF BLOCKADE	SENSORY BLOCKADE	1191.4	77.8	1354.3	73.8	162.9	-8.035	0.0001
	MOTOR BLOKADE	1077.9	84	1221.4	83.6	143.6	-6.409	0.0001

The comparison of sensory block onset and progression between 2 mg and 4 mg perineural Dexamethasone revealed that the higher dose (4 mg) consistently led to a faster and more complete sensory blockade in the initial assessment periods. At 5 minutes, a significantly higher proportion of patients in the 4 mg group achieved good sensory block compared to the 2 mg group (96.4% vs 67.9%,

p=0.009). This early advantage persisted at 15 minutes, where 85.7% of the 4 mg group demonstrated good sensory block, compared to only 60.7% in the 2 mg group (p=0.035). However, by 20 minutes onwards, both groups converged, achieving near-complete sensory blockade with no significant differences between them, indicating that while both doses ultimately provide effective sensory blockade, 4 mg Dexamethasone accelerates the onset, which may improve early intraoperative comfort and reduce the need for supplemental analgesia (Table 4).

Table 4. Association between Group and Sensory Block

PARAMETERS		No perception		Diminished perception		Normal perception		CSV	P VALUE
		F	%	F	%	F	%		
S5	2 mg	1	3.6	18	67.9	8	28.6	9.391	0.009
	4 mg	1	3.6	27	96.4	0	0.0		
S10	2 mg	9	32.1	19	67.9	0	0	1.845	0.174
	4 mg	14	50.0	14	50.0	0	0		
S15	2 mg	17	60.7	11	39.3	0	0	4.462	0.035
	4 mg	24	85.7	4	14.3	0	0		
S20	2 mg	27	96.4	1	3.6	0	0	0.000	1.000
	4 mg	27	96.4	1	3.6	0	0		
S25	2 mg	28	100.0	0	0.0	0	0	1.018	0.313
	4 mg	27	96.4	1	3.6	0	0		
	4 mg	28	100.0	0	0.0	0	0		

For motor block, the 4 mg Dexamethasone group consistently outperformed the 2 mg group in terms of faster onset and better quality of motor blockade during the initial 25 minutes after block administration. At 5 minutes, good motor block was seen in 60.7% of the 4 mg group compared to only 14.3% in the 2 mg group ($p<0.001$), demonstrating a markedly faster onset with the higher dose. This trend continued at 15 minutes (53.6% vs 14.3%, $p=0.002$) and 20 minutes (78.6% vs 50%, $p=0.026$), with the 4 mg group showing statistically superior motor blockade at these critical early time points. By 30 minutes, both groups achieved near-complete motor block (100% in the 4 mg group and 89.3% in the 2 mg group). Both doses eventually ensure adequate motor blockade, but the faster onset associated with 4 mg Dexamethasone may facilitate quicker surgical readiness and enhance operating conditions in the early phase of surgery (Table 5).

Table 5: Association Between Group and motor block

PARAMETERS		No perception		Diminished perception		Normal perception		CSV	P VALUE
		F	%	F	%	F	%		
M5	2 mg	0	0	4	14.3	24	85.7	12.876	0.000
	4 mg	0	0	17	60.7	11	39.3		
M10	2 mg	0	0.0	28	100.0	0	0	4.308	0.038
	4 mg	4	14.3	24	85.7	0	0		
M15	2 mg	4	14.3	24	85.7	0	0	9.639	0.002
	4 mg	15	53.6	13	46.4	0	0		
M20	2 mg	14	50.0	14	50.0	0	0	4.978	0.028
	4 mg	22	78.6	6	21.4	0	0		
M25	2 mg	23	82.1	5	17.9	0	0	5.490	0.019

	4 mg	28	100.0	0	0.0	0	0		
M30	2 mg	25	89.3	3	10.7	0	0	3.170	0.075
	4 mg	28	100.0	0	0.0	0	0		

Discussion

Post-operative pain remains one of the most common and distressing complaints among patients undergoing upper limb surgeries. Managing this pain effectively is critical, as the use of multiple systemic analgesics in the post-operative period is often associated with undesirable adverse effects. In this context, the brachial plexus block offers a safe, simple, and effective technique for providing adequate post-operative analgesia. Additionally, it helps avoid the potential complications and side effects associated with general anesthesia, making it a preferred option for upper limb surgeries [7].

The duration of single shot nerve blocks are variable and hence various adjuvants have been added to local anesthetics with the aim of prolonging the sensory blockade and enhancing the quality of the regional block [8]. Among the adjuvants, glucocorticoids, especially Dexamethasone, has emerged as a promising agent. When used as an adjuvant in brachial plexus blocks, Dexamethasone has been shown to significantly prolong analgesia with minimal adverse effects, making it a valuable addition to local anesthetics [9-11].

Administration of Dexamethasone perineurally is being researched more in recent years, with substantial evidence supporting its efficacy. Its mechanism of action is assumed to involve the potentiation of inhibitory potassium channels on nociceptive C fibers. Dexamethasone may also show a vasoconstrictive effect, contributing to slower systemic absorption of the local anesthetic, thereby prolonging the duration of analgesia [12,13].

In our study, we compared the onset and duration of sensory and motor blockade between 2 mg and 4 mg perineural Dexamethasone administered with bupivacaine in ultrasound-guided interscalene block among 56 patients undergoing shoulder arthroscopy. Both groups were comparable in terms of demographic characteristics, including age, gender, height, weight, and BMI, with no statistically significant differences between them. Similarly, baseline hemodynamic parameters such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and oxygen saturation (SpO2) were comparable between the two groups. This ensured that the observed differences in block characteristics could be attributed to the differing doses of Dexamethasone rather than pre-existing variability between groups.

The mean time to onset of sensory blockade in the 2 mg Dexamethasone group was 4.92 minutes, whereas in the 4 mg Dexamethasone group, it was

significantly faster at 3.35 minutes. This statistically significant difference (p=0.0001) confirms that a higher dose of Dexamethasone leads to faster sensory block onset. Similarly, the mean time to onset of motor blockade was 6.39 minutes in the 2 mg group and 5.14 minutes in the 4 mg group, again demonstrating significantly faster motor block onset with the higher Dexamethasone dose (p=0.0001).

These findings are consistent with the results reported by Islam SM et al[14], who demonstrated significantly earlier onset of both sensory and motor blockade when Dexamethasone was added to local anesthetics in brachial plexus blocks. The dose-dependent enhancement of onset time seen in our study reinforces the role of Dexamethasone in improving the efficacy of peripheral nerve blocks, particularly in the interscalene approach.

The mean duration of sensory blockade in the 2 mg Dexamethasone group was 1191.42 minutes, compared to 1354.28 minutes in the 4 mg group, showing a statistically significant prolongation with the higher dose (p=0.0001). Similarly, the mean duration of motor blockade was 1077.85 minutes in the 2 mg group and 1221.42 minutes in the 4 mg group, again with a statistically significant difference favoring the higher dose (p=0.0001). This confirms that increasing the dose of perineural Dexamethasone not only accelerates onset but also prolongs both sensory and motor blockade in a dose-dependent manner.

A noteworthy observation in our study was the earlier regression of motor blockade compared to sensory blockade, which aligns with the findings reported by De Jong et al. [15]. This is a common feature in peripheral nerve blocks, where sensory function typically recovers more gradually than motor function, which may allow for extended pain relief even after motor function returns.

Our results are also consistent with findings from Albrecht et al[16], who evaluated 1 mg and 4 mg doses of Dexamethasone combined with local anesthetics for interscalene blocks. Their study concluded that the duration of analgesia increased in a dose-dependent manner, a trend that was also clearly observed in our study. Furthermore, Phanijphum et al[17] in Thailand found that adding 4 mg Dexamethasone to a supraclavicular block resulted in significantly longer duration of analgesia compared to 2 mg Dexamethasone, further supporting our findings that higher doses of Dexamethasone offer superior prolongation of block duration.

Conclusion

This study comparing the effects of 2 mg and 4 mg perineural Dexamethasone in ultrasound-guided interscalene brachial plexus block for patients undergoing shoulder arthroscopy demonstrated that a higher dose of Dexamethasone (4 mg) offers significant advantages over the lower dose (2 mg). Specifically, 4 mg Dexamethasone led to a faster onset of both sensory and motor blockade, along with a significantly prolonged duration of both sensory and motor block. Incorporating 4 mg Dexamethasone into regional anesthesia protocols for shoulder arthroscopy may contribute to improved patient comfort, reduced need for rescue analgesics, and overall enhanced perioperative care.

Statements and Declarations

Limitations of the study

Single center study and Small sample size

Conflicts of interest

The authors declare that they do not have conflict of interest.

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References

1. Rawal N, Hylander J, Nydahl PA, Olofsson I, Gupta A. Survey of postoperative analgesia following ambulatory surgery. Acta Anaesthesiol Scand. 1997 Sep;41(8):1017–22.
2. Ilfeld BM. Continuous peripheral nerve blocks: a review of the published evidence. Anesth Analg. 2011 Oct;113(4):904–25.
3. Salinas FV. Location, location, location: Continuous peripheral nerve blocks and stimulating catheters. Reg Anesth Pain Med. 2003 Mar 1;28(2):79–82.
4. Yadav RK, Sah BP, Kumar P, Singh SN. Effectiveness of addition of neostigmine or dexamethasone to local anaesthetic in providing perioperative analgesia for brachial plexus block: A prospective, randomized, double blinded, controlled study. Kathmandu Univ Med J KUMJ. 2008 Sep;6(23):302–9.
5. Shrestha BR, Maharjan SK, Tabedar S. Supraclavicular brachial plexus block with and without dexamethasone - a comparative study. Kathmandu Univ Med J KUMJ. 2003 Sep;1(3):158–60.
6. Albrecht E, Vorobeichik L, Jacot-Guillarmod A, Fournier N, Abdallah FW. Dexamethasone Is Superior to Dexmedetomidine as a Perineural Adjunct for Supraclavicular Brachial Plexus Block: Systematic Review and Indirect Meta-analysis. Anesth Analg. 2019 Mar;128(3):543–54.
7. Parveen S, Athaluri VV, Lakshmi BS. Effect of Intravenous Dexamethasone in Prolonging the Duration of Supraclavicular Brachial Plexus Block with 0.5% Ropivacaine: A Prospective, Randomized, Placebo Controlled Study. Int J Sci Stud2015;2(10):56-60.
8. McCartney CJ, Brull R, Chan VW, Katz J, Abbas S, Graham B, *et al.* Early but no long-term benefit of regional compared with general anesthesia for ambulatory hand surgery. Anesthesiology 2004;101:461-7.
9. Albrecht E, Kern C, Kirkham KR. A systematic review and meta-analysis of perineural dexamethasone for peripheral nerve blocks. Anaesthesia2015;70:71-83
10. Marks R, Barlow JW, Funder JW. Steroid-induced vasoconstriction: Glucocorticoid antagonist studies. J Clin Endocrinol Metab 1982;54:1075-7.
11. Fredrickson M.D., M., Danesh-Clough M.D.,T., and White, R. (2013). Adjuvant dexamethasone for bupivacaine sciatic and ankle blocks: results from two randomized placebo-controlled trials. Regional Anesthesia and Pain Medicine, doi:10.1097/AAP.0b)13e318292c121.
12. Movafegh A, Razazian M, Hajimaohamadi F, Meysamie A.

Dexamethasone added to lidocaine prolongs axillary brachial plexus blockade. Anesth Analg. 2006 Jan;102(1):263–7.
13. 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 Anesth. 2011 Oct;25(5):704–9.
14. Islam SM, Hossain M, Maruf AA. Effect of Addition of dexamethasone to Local Anaesthetics in Supraclavicular Brachial Plexus Block. J Armed Forces Med Coll Bangladesh. 2011;7(1):11–4.
15. De Jong RH; Wagman IH. Physiological mechanism of peripheral nerve block by local anesthetics. Anesthesiology 1963;24:684-7.
16. Albrecht E, Reynvoet M, Fournier N, Desmet M. Dose-response relationship of perineural dexamethasone for interscalene brachial plexus block: a randomised, controlled, triple-blind trial. Anaesthesia. 2019 Aug;74(8):1001–8.
17. View of A comparison study of 2 mg versus 4 mg of dexamethasone combined with local anesthetic drug in increasing the analgesic duration of a single-shot supraclavicular brachial plexus block. Available from: https://he02.tci-thaijo.org/index.php/anesthai/article/view/110601/86701