The effect of Dexamethasone on duration of surgical anesthesia and postoperative analgesia in USG guided ankle block using 0.5% ropivacaine for foot surgeries

Kaushal Singh Baghel, Astha Agarwal, Pooja Mongia, Aditi Chittora, Sudhir Sachdev, Vijay Mathur, Nikita Pal
Department of Anesthesiology, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan, India.

Abstract

Background and aims: This study aims to determine the effect of adjuvant like dexamethasone on prolongation of ankle block using ropivacaine as local anesthetic in terms of time of first rescue analgesic within 24 hours, total dose of analgesic requirement within 24 hours and hemodynamic parameters.

Methods: A total of 60 participants were randomly assigned to Group R (n=30) or Group RD (n=30). The primary outcome was the duration of analgesia, and secondary outcomes included pain scores (VAS), hemodynamic parameters (heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and respiratory rate), and total analgesic dosage. Statistical analyses were conducted using independent t test and chi square test, with level of significance set at $p<0.05$.

Results: Group RD demonstrated a significantly longer mean duration of analgesia (10.63± 2.08 hours) compared to Group R (5.23 ± 0.74 hours; $p<0.001$). Pain scores at 4 hours were lower in Group RD (VAS = 0.13 ± 0.51) compared to Group R (VAS = 1.27 ± 0.98; $p<0.001$). Hemodynamic parameters showed significant differences at 4 and 12 hours between the groups, with Group RD experiencing increases in pain and hemodynamic changes at 12 hours. Total analgesic dosage was also significantly higher in Group R.

Conclusion: The addition of dexamethasone to ropivacaine significantly prolongs the duration of analgesia and alters pain and hemodynamic profiles compared to ropivacaine alone. These findings highlight the benefit of incorporating dexamethasone in enhancing postoperative pain management.

Keywords: Ankle block, dexamethasone, ropivacaine, analgesia

Introduction:

Central neuraxial blocks for ankle & foot surgeries are not preferred nowadays due to evolution of USG guided ankle blocks. USG guided ankle block has more success rate than landmark guided block and offers effective analgesia both the intraoperative & postoperative periods. Requirements of rescue analgesics are very less, hence during foot surgeries, ankle blocks are frequently utilized as a sole surgical anesthetic technique. This block can be safely performed in patients with various comorbidities and offers a safer alternative to general anesthesia and central neuraxial blocks. Complications associated with general anesthesia and central neuraxial blocks are also avoided & overall helps in improving the patient satisfaction scores. Since this procedure doesn't require any specialized equipment, knowledge of Sono anatomy of foot and technique of giving block is sufficient. It is dependent upon anatomical landmarks that may be quickly and easily recognized. Five injections are used in the ankle block to anaesthetize two deep and three superficial nerves. The superficial peroneal nerve, the sural nerve, and the saphenous nerve are among the three superficial nerves; the tibial nerve and the deep peroneal nerve are the two deep nerves. Compared to the sciatic and popliteal blocks, this block allows early mobilization by preserving proximal motor functions[1-4].

Address for Correspondence:

Dr. Kaushal Singh Baghel
Department of Anesthesiology,
Mahatma Gandhi University of Medical Sciences and Technology,
Jaipur, Rajasthan, India.
Email: dr.ksbaghel2015@gmail.com

Ankle blocks may be recommended for a number of foot surgeries including osteotomy, bunionectomy, forefoot reconstruction in outpatient surgeries, fracture pain management, and analgesia for soft tissue injuries. Additionally, it is crucial for both treatments and diagnosis. Ankle block should be avoided in patients who have infection, oedema, soft tissue damage and bleeding tendencies[5-7]

Much progress has been made in the field of regional anesthesia with the use of advanced USG machines with artificial intelligence (AI) technology. Some of these advancements make it easier for anesthesiologists to accurately identify nerves and their branches, making it simple to monitor the local anesthetic spread during injection and reducing the time of onset of block. It overall increases the success rate of the block [8-9].

Ropivacaine is thought to be preferable over bupivacaine due to lesser side effects. Comparing ropivacaine to bupivacaine, the former is less hazardous to the central nervous system and the heart. Though duration is little less as compared to bupivacaine so there is a need of increasing the duration of the block. Several medications including ketamine, dexamethasone, clonidine, opioids, and adrenaline, have been researched as adjuvants for regional anesthesia. It is anticipated that these adjuvant medications, when given to peripheral nerve block, will lengthen motor blockade and prolong analgesia without having any negative systemic consequences. In various published studies, where dexamethasone was used as an adjuvant in different regional blocks, it has been shown that it has increased the duration of block significantly with very less side effects [10].

The purpose of this study was to determine the effect of adjuvant like dexamethasone on prolongation of ankle block using ropivacaine as local anesthetic in terms of time of first rescue analgesic within 24 hours, total dose of analgesic requirement within 24 hours and hemodynamic parameters.

Materials and methods:

After the Institute's Ethics Committee clearance and written informed consent, patients planned for foot surgeries were included in this study. Complete Pre Anesthetic Evaluation was performed a day before the surgery.

Inclusion criteria:

Patients who were willing to participate in this study by written and informed consent. Patients scheduled for foot surgeries. Patients of either sex having age 18-65 years. Patient with ASA grade I & II.

Exclusion criteria:

Patient's refusal for peripheral nerve block. Patients allergic to local anesthetic drugs. Patients on opioids and other analgesics for chronic pain. Neurological deficits.

Dosage of drugs:

Group R (Control group) received local injection of 18 ml of 0.5% ropivacaine and 2 ml normal saline.

Group RD (Test group) received local injection of 18 ml of ropivacaine 0.5% and 2 ml (8 mg) dexamethasone

Sample size calculation:

Sample size calculation was done according to the study by **Gao M et al** using the following formula [11]:

$$N = \frac{2(Z\alpha/2+Z\beta)^2\sigma^2}{d2}$$

Where,

N = Sample size per group

Zα/2 = 1.96 at the desired significance level of 5%

Zβ = 0.84 at the desired power of 80%

d = Mean difference of clinical significance =1.20

σ = Standard deviation = 1.65

Putting the values we get N ≈ 30 hence the required sample size for the present study is = (2 × 30) = 60

On the day of surgery on arrival in the operation room, standard ASA monitoring was set up. Patients were randomized using the chit in a box method for group assignment in one of the two groups of 30 patients each. Group assignment was performed by a nurse who does not participate in the study. Observation and follow-up of the groups were performed by specialists who were not part of study. Group I (n=30, control group: Ropivacaine group) received local injection of 18 ml of 0.5% ropivacaine and 2 ml normal saline and Group II (n=30, Test Group - Dexamethasone group) received local injection of 18 ml of ropivacaine 0.5% and 2 ml (8 mg) dexamethasone respectively for USG guided ankle block (Sono site Turbo M).

In Operation Theatre standard monitoring- ECG, NIBP & SpO2 was started. All sterile aseptic precautions were taken on the opposite side of the foot that was blocked. Prior to the procedure Local Anesthetic sensitivity was checked by injecting 0.5ml LA subcutaneously and anxiolysis like midazolam 0.03mg/kg was given. The entire foot was cleaned with disinfectant. Tibial nerve was blocked first as it takes 20min for the block to act and the other nerve blocks tend to onset more swiftly.

Statistical analysis:

The data were tabulated in Microsoft Excel and analyzed with SPSS V.24 software. The continuous

variables are presented with mean and standard deviation. The categorical variables are presented with frequency and percentage. Chi square test, independent t test are used for the statistical analysis. The p value ≤0.05 is considered statistically significant.

Results:

In our study, the mean age for Group R is 42.73 ± 13.25 years, while for Group RD, it is 41.20 ± 10.85 years. The p-value is 0.626, indicating that the difference in mean age between the two groups is not statistically significant. In Group R, 8 participants (26.7%) are female, and 22 participants (73.3%) are male. In Group RD, 9 participants (30.0%) are female, and 21 participants (70.0%) are male. The total number of participants is 60, with no significant difference in sex distribution between the groups (p = 0.774). Group R has a mean BMI of 23.04 ± 2.04 kg/m², while Group RD has a mean BMI of 22.88 ± 2.29 kg/m². The p-value is 0.776, indicating no significant difference in BMI between the groups. In Group R, 15 participants (50.0%) are ASA grade I, and 15 participants (50.0%) are ASA grade II. In Group RD, 16 participants (53.3%) are ASA grade I, and 14 participants (46.7%) are ASA grade II. The p-value is 0.796, showing no statistically significant difference in ASA grade distribution between the groups (Table 1). Total dosage of analgesic in 24 hours was significantly higher in Group R (Table 2).

Table 1: Comparison of general characteristics

General characteristics	Group R	Group RD	P value
Age (years)	42.73 ± 13.25	41.20 ± 10.85	0.626
Male/Female	22/8	21/9	0.774
BMI (kg/m²)	23.04 ± 2.04	22.88 ± 2.29	0.776
ASA Grade I/II	15/15	16/14	0.796

Table 2: Comparison of Total dosage of analgesic in 24 hours

Parameter	Group	Mean	SD	P value
Total dosage of analgesic in 24 hours	Group R	2.50	0.51	<0.001*
	Group RD	1.13	0.35	

The overall hemodynamics were comparable between the groups. Group R and Group RD, at the 4 and 12-hour marks the mean HR shows a statistically significant difference. Group R and Group RD, at the 4 and 12-hour marks the mean SBP shows a statistically significant difference. Group R and Group RD, at the 4 and 12-hour marks the mean DBP shows a statistically significant difference. Group R and Group RD, at the 4 and 12-hour marks the mean MAP shows a statistically significant difference. No significant differences in SPO2 are observed at any time point. Group R and Group RD, at the 4 and 12-hour marks the mean RR shows a statistically significant difference.

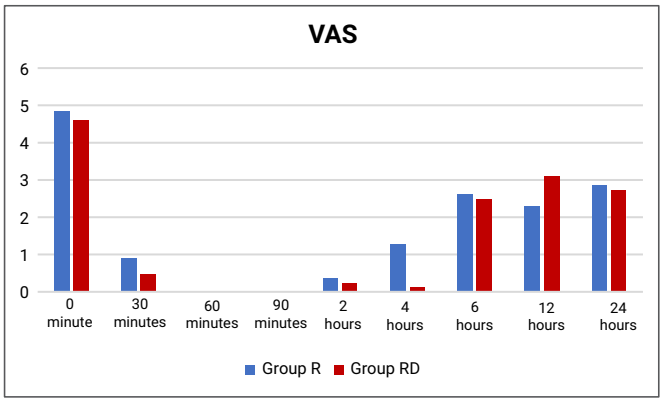

Figure 1: Comparison of pain (VAS score)

The mean VAS score at 0 minutes for Group R is 4.83 ± 0.75, while for Group RD it is 4.61± 0.81, with a P value of 0.217, indicating no significant difference. At 30 minutes, the mean VAS score for Group R is 0.90 ± 0.84, compared to 0.47 ± 0.25 for Group RD, with a P value of 0.064, showing a trend toward significance. At 60 and 90 minutes, both groups have a mean VAS score of 0.00 ± 0.00, with no significant difference observed. At 2 hours, Group R has a mean VAS score of 0.97 ± 0.49, and Group RD has a mean VAS score of 0.62 ± 0.13, with a P value of 0.077, indicating no significant difference. At 4 hours, Group R has a mean VAS score of 1.27 ± 0.98, while Group RD has a significantly lower mean VAS score of 0.13 ± 0.51, with a P value <0.001. At 6 hours, the mean VAS scores are 2.62 ± 0.84 for Group R and 2.47 ± 1.11 for Group RD, with a P value of 0.193, indicating no significant difference. At 12 hours, Group R has a mean VAS score of 2.30 ± 0.79, whereas Group RD has a significantly higher mean VAS score of 3.10 ± 1.18, with a P value of 0.003. At 24 hours, the mean VAS scores are 2.87 ± 1.78 for Group R and 2.71 ± 0.49 for Group RD, with a P value of 0.068, indicating no significant difference (Figure 1).

Table 3: Comparison of duration of analgesia

Parameter	Group	Mean	SD	P value
Duration of analgesia (hours)	Group R	5.23	0.74	<0.001*
	Group RD	10.63	2.05	

The mean duration of analgesia for Group R is 5.23 ± 0.74 hours, while for Group RD, it is significantly longer at 10.63 ± 2.08 hours, with a P value of <0.001 (Table 3). This indicates that Group RD experienced a significantly longer duration of analgesia compared to Group R.

The pain and different hemodynamic parameters were significantly increased in Group R at 4 hours and in Group RD at 12 hours. Group RD showed significantly increased pain and different hemodynamic parameters as the effect of the block weaned off in this group but not in Group R due to the effects of rescue analgesia.

Discussion:

The study investigates the impact of adjuvant dexamethasone on the duration of analgesia when used in conjunction with ropivacaine in ultrasound-guided (USG) ankle blocks. Regional anesthesia techniques, such as the ankle block, are commonly employed to provide effective pain relief for various foot and ankle surgeries. Ropivacaine, a long-acting local anesthetic, is frequently utilized due to its favorable safety profile and duration of action. However, there is a continuous quest to enhance and prolong postoperative analgesia to improve patient comfort and outcomes. This study focuses on the addition of dexamethasone, a corticosteroid with anti-inflammatory properties, to ropivacaine to assess its efficacy in extending the duration of analgesia. By evaluating the combination's effectiveness, the research aims to offer insights into optimizing pain management strategies in ankle surgeries.

In our study, the mean age for Group R is 42.73 years, and for Group RD, it is 41.20 years, with no significant difference ($p = 0.626$). Group R has 26.7% female and 73.3% male participants, while Group RD has 30.0% female and 70.0% male participants, with no significant difference in sex distribution ($p = 0.774$). The mean BMI for Group R is 23.04 kg/m² and for Group RD is 22.88 kg/m² ($p = 0.776$). ASA grade distribution is also similar between groups, with no significant difference ($p = 0.796$).

Fang et al stated that, the mean age for Dexamethasone Group is 54.6 ± 17.3 years, while for Control Group, it is 54.1 ± 16.1 years [12]. In Dexamethasone Group, 23 participants (36.5%) are male, and 40 participants (63.4%) are female. In Control Group, 24 participants (40%) are male, and 36 participants (60%) are female. Gao et al stated that, the mean age for Group C is 43.3±12.9 years, while for Group IV, it is 44.3±14.5 years. In Group C, 47 (72.3%) are male, and 18 (27.7%) are female. In Group IV, 39 (60.0%) are male, and 26 (40.0%) are female; Group C has a mean BMI of 25.6±3.0 kg/m², while Group IV has a mean BMI of 25.7±3.3 kg/m². The p-value is 0.847, indicating no significant difference in BMI between the groups. In Group C, 41 (63.0%) are ASA grade I, and 24 (36.9%) are ASA grade II. In Group IV, 38 (58.5%) are ASA grade I, and 27 (41.5%) are ASA grade II which is corresponding to our study.

In the present study, Group RD (receiving dexamethasone with ropivacaine) experienced a significantly longer duration of analgesia compared to Group R (receiving only ropivacaine). Pain and various hemodynamic parameters increased significantly at 4 hours in Group R and at 12 hours in Group RD. As the block effect wore off, pain and hemodynamic parameters increased significantly in Group RD, whereas in Group R, the effects of rescue analgesia prevented such increases. Our study is comparable with the study conducted by Ashraf et al on preemptive ankle block using a combination of ropivacaine and dexamethasone in improving postoperative analgesia after foot surgery in patients in general anesthesia [13]. He stated that adding dexamethasone to ropivacaine improved preemptive ankle block analgesia by decreasing pain intensity and analgesic consumption with minimal postoperative complication.

In contrast to our study and to the previous studies that showed beneficial effect of dexamethasone in prolongation of postoperative analgesia when added to local anesthetic, Parrington et al in a study done to evaluate adding dexamethasone to mepivacaine in supraclavicular brachial plexus block, they were unable to demonstrate augmentation or prolongation of postoperative analgesia, this difference may be attributed to difference in the study methodology, type of local anesthetic, and volume of local anesthetic[14]. Bardan et al concluded that group (Bupivacaine alone) had a higher VAS, heart rate and mean arterial pressure as compared to group (Bupivacaine with dexamethasone group) in USG guided interscalene block [15].

The present study showed that the addition of dexamethasone to ropivacaine reduced overall pain scores and analgesic requirement in postoperative period without any serious adverse effects. In our study no side effects of block were found. Adverse effects with a single dose of dexamethasone are rare and minor in nature and the previous studies have demonstrated that short-term use of dexamethasone is safe [16-20].

Conclusion:

This study provides compelling evidence that the incorporation of adjuvant dexamethasone to ropivacaine in ultrasound-guided ankle blocks significantly extends the duration of analgesia. The findings indicate that dexamethasone is an effective adjunct to local anesthetics, markedly enhancing pain relief and potentially improving postoperative comfort for patients undergoing ankle surgery. The enhanced analgesic effect attributed to dexamethasone may result from its anti-inflammatory properties and its

ability to inhibit nociceptive signaling pathways, thereby prolonging the action of local anesthetics. Despite these considerations, the current evidence robustly supports the clinical integration of dexamethasone in regional anesthesia protocols. Its use could lead to enhanced analgesic outcomes, thereby improving patient satisfaction and overall postoperative recovery. This advancement in pain management underscores the potential for adjuvant therapies to enhance the efficacy of established anesthetic techniques. Future research is recommended to optimize the dosing regimen of dexamethasone in this context, as well as to confirm these results across larger and more heterogeneous patient populations.

Recommendations:

1. The block has been performed under a controlled environment so the efficacy and utilization of the block is difficult to obtain in emergency conditions.
2. Sample size included patients from 18-65yrs therefore for we did not perform block in patients beyond this age group so establishment of efficacy in those patients was not established.
3. Since it's an ultrasound guided block, set up with resource limitation or those who depend on peripheral nerve stimulators might not get 100% success.
4. The study included 60 patients (30 per group). While this was sufficient to detect statistically significant differences in the primary and secondary outcomes, a larger sample size would increase the reliability and generalizability of the findings.

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Department of General surgery, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, Rajasthan.

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