OBJECTIVE: Pectoral nerve (Pecs) block is now an established modality for post-operative analgesia following breast surgery. This study compares the efficacy of magnesium sulphate as an adjunct to bupivacaine in ultrasound guided Pecs block. Methods: Forty patients with American Society of Anesthesiologists' physical status 1 or 2 undergoing modified radical mastectomy with axillary dissection were recruited for the study. In Group 1 (LA)(n=20), patients received 18 mL 0.25% bupivacaine (45 mg) with 2 mL NS, with 10 ml in Pec I and 10 ml in Pec II block. The patients in Group 2 (LA with magnesium) (n = 20) received 18 mL 0.25% bupivacaine (45 mg) with 1.5 mL (150 mg) of MgSO4 and 0.5 mL NS, again 10 ml at each level. Patients were evaluated for pain scores at 0, 2, 4, 6, 12, 18 and 24 h, duration of post-operative analgesia and rescue analgesic doses required. Non-normally distributed data were analysed using the Kruskal-Wallis test. Analgesic rescue was evaluated using visual analogue scale scores. Results: The mean duration of analgesia was significantly prolonged in Group 2 compared to Group 1 (P<0.001). The total dose of rescue analgesic was also more in Group 1 compared to Group 2 (P<0.001). Conclusions: Magnesium sulphate in a dose of 150 mg is effective in prolonging the duration and quality of analgesia when added as an adjunct to bupivacaine in ultrasound guided Pecs block.

INTRODUCTION

Optimal pain relief after oncological surgeries pose a major challenge in perioperative patient care. Breast cancer is the second most common tumor in females,[1,2] and most breast cancer surgeries are performed under general anesthesia which is not adequate to provide postoperative pain control. Ultrasound-guided pectoral nerves type I and II blocks have come up as an alternative to paravertebral blocks and thoracic epidurals with proven role for postoperative pain relief.[3,4]

But the duration of PEC blocks is limited to the effect of administered local anesthetics (LA). However, recently adjuvants such as dexmedetomidine,[5] dexamethasone[6] are added to the LA solution in concentrations advocated for other peripheral blocks to prolong the effect of PEC blocks with promising results. Evidence further supports the presence of N-methyl-D-aspartate (NMDA) receptors in skin and muscles[7] and this has led to the use of magnesium sulphate (MgSO4; NMDA antagonist) as an adjunct to LA via different routes. So far the role of MgSO4 as an adjuvant to LA has been studied in brachial plexus block,[8] transversus abdominis plane block[9] and also via neuraxial route.[10] But data establishing its role in Pecs block with respect to its efficacy, dose required, and duration of analgesia is limited.

Therefore, we intended to evaluate the role of MgSO4 as an adjuvant to bupivacaine in ultrasound (USG)-guided Pecs blocks for post-operative analgesia in patients scheduled for modified radical mastectomy (MRM) under general anesthesia (GA). Our aim was to primarily assess the effect of magnesium sulphate as an adjuvant to bupivacaine in pects block, on the duration of postoperative analgesia, postoperative pain scores, total consumption of analgesics in 24 h, and secondarily to evaluate the patient’s satisfaction scores, and any incidence of adverse events.

*Corresponding author: Dr Ankita Chandel
Assistant Professor, Department of Anaesthesia, Dr RKGMC Hamirpur
METHODOLOGY

After approval by the Institutional Ethics Committee, this study was carried out in 40 adult female patients (35–65 years age group) belonging to American Society of Anesthesiologists physical status 1 or 2 scheduled for MRM under general anesthesia over a period of 12 months. The exclusion criteria included patient's refusal to block, local infection at the site of block, patients on calcium channel blockers and patients with coagulopathies.

The patients were randomly allocated by a computer-generated random number table into two groups Group 1 (LA), and Group 2 (LA with magnesium) of 20 patients each. Allocation concealment was ensured by having the random group assignment enclosed in a sealed opaque envelope. The sealed envelope was opened by an anaesthesiologist not involved in the study. The observer who collected the peri-operative data as well as the patient was masked to the technique of analgesia performed.

During the pre-anaesthetic visit, the patients were explained about the study purpose, advantages and risks of procedure and instructed to demand analgesia as per requirement. Patients were educated about the 10 cm visual analogue scale (VAS) during the pre-operative assessment. All the patients were kept nil orally for 8 h before surgery, and pre-medication with oral alprazolam 0.5 mg and oral ranitidine 150 mg was given night before surgery.

All patients received general anaesthesia. Pre-oxygenation was done with 100% oxygen for 3 min. Induction was done with propofol 2 mg/kg intravenous (IV), fentanyl 2 μg/kg IV and atracurium 0.5 μg/kg IV to facilitate endotracheal intubation. Maintenance was with oxygen:nitrous oxide:isoflurane in the ratio of 33:66:1%. Muscle relaxation was maintained with atracurium 0.1 mg/kg IV as and when required. Diclofenac sodium 75 mg IV was also administered intraoperatively.

Before commencement of surgery, Pecs (I and II) blocks were performed with the patient in supine position, placing the ipsilateral upper limb in abduction position with a 22-gauge spinal needle using Sonosite™MicroMaxx machine, linear high frequency probe, (6-13 MHz). The ultrasound probe was first placed at infraclavicular region after skin sterilisation and moved laterally to locate the axillary artery and vein directly above the 1st rib where pectoralis major and pectoralis minor muscles were identified. The needle was inserted in plane with probe to the fascial plane between pectoralis muscles, and 10 ml of remaining respective drug solution was injected.

In Group 1 (LA)(n=20), patients received 18 mL 0.25% bupivacaine (45 mg) with 2 mL NS, with 10 mL in Pec I and 10 ml in Pec II block. The patients in Group 2 (LA with magnesium) (n = 20) received 18 mL 0.25% bupivacaine (45 mg) with 1.5 mL (150 mg) of MgSO₄ and 0.5 mL NS, again 10 ml at each level.

After completion of surgery, residual neuromuscular blockade was antagonised with neostigmine 0.05 mg/kg IV and glycopyrrolate 0.01 mg/kg IV. All patients were extubated and transferred to the post-operative ward.

Postoperatively, the patients were evaluated for pain scores using VAS (0–10, with 0 as no pain and 10 being maximum possible pain) in the post-anaesthesia care unit at time 0 (just after extubation), 2, 4, 6, 12 and 24 h by an investigator blinded to the group assignment. As per institutional protocol, injection diclofenac sodium 75 mg slow IV, 8 hourly, was administered.

The primary outcome measure in this study was the post-operative VAS scores at time 0 (just after extubation), 2, 4, 6, 12 and 24 h. The secondary outcome measures included the duration of post-operative analgesia, that is, time to first analgesic request from the time of giving block and the number of supplemental analgesic requirements. All the patients were also evaluated for any complications arising, for example, LA toxicity, vascular puncture, pleural puncture and pneumothorax.

Data were collected and entered in Microsoft Excel 2010. Statistical analysis was performed using SPSS software version 20. The one-sample Kolmogorov–Smirnov test was employed to determine whether data sets differed from a normal distribution. Normally distributed data were analysed using a repeat-measures general linear model analysis of variance for time-related variables, whereas non-normally distributed data were analysed using Kruskal-Wallis test. P < 0.05 was considered statistically significant. Patients were asked to rate on a 3-point scale regarding their satisfaction with pain management: Highly satisfied (1), satisfied (2) or dissatisfied (3).

The primary outcome measure in this study was the post-operative VAS score. The secondary outcome measures included the number of supplemental analgesic requirements, duration of post-operative analgesia that is time to first analgesic request from the time of giving block, nausea vomiting score and patient's satisfaction. All the patients were monitored in the peri-operative period for hemodynamic stability and any side effects.

Sample size was estimated using pain scores as the primary variable. Literature review showed that there is an average difference of 10 mm on VAS of 10 cm with standard deviation of 10 mm. Assuming a standard deviation of 10 mm, the minimum needed sample size to detect a difference of 10 mm on VAS of 10 cm with alpha error of 0.05 and power of study 80% was 54. Thus, each group required at least 18 patients. Hence, a total of 40 patients were enrolled to compensate for any probable block failures and dropouts.

RESULTS

A total number of patients enrolled during the study period were 40 in both groups being 20 and 20. They were comparable with each other with respect to age, weight and duration of surgery.[Table 1]

The difference in mean VAS at 0 and 2 h (VAS-0, VAS-2 h) was found to be statistically insignificant. However, there was a statistically significant decrease in VAS scores at 4, 6, 12, 18...
Mean duration of analgesia was significantly prolonged in Group 2 compared to Group 1 (592 ± 180.63 min vs. 397.67 ± 92.84 min; *P* < 0.001). The total dose of rescue analgesic was also more in group 1 compared to group 2. (90.23 ± 2.34 mg vs. 75.46 ± 15.40 mg; *P* < 0.001).

**DISCUSSION**

The pectoral nerve (Pecs) block, first described by Blanco et al.,[11,12] is an interfascial plane block where LA is deposited into the plane lying between the pectoralis major and the pectoralis minor muscles (Pecs I block) and above the serratus anterior muscle at the third rib (Pecs II block). The Pecs block is now an established modality to control acute postoperative pain after breast surgery. But, the duration of analgesic effect is limited by the duration of local anaesthetic administered.

Adjuvants like dexmedetomidine, dexamethasone have been tried to prolong the duration of Pecs block. Dexmedetomidine has been shown to increase the duration of analgesic effect by 40% along with improving the quality of analgesia.[5] Similarly duration of analgesic effect has been claimed to be almost 8 h when dexamethasone is added to LA.[6]

Magnesium sulphate is another commonly used adjuvant to LA and has been proven to prolong analgesia owing to its antagonistic role on NMDA receptors. The NMDA receptors play an important role in central nociceptive transmission, modulation and sensitisation of acute pain states. Magnesium causes voltage-dependent antagonism of NMDA receptors, leading to the prevention of central sensitisation from peripheral nociceptive stimulation and a decrease in acute pain after tissue injury. The presence of NMDA receptors at various sites including the muscle,[7,8] skin,[9,10] knee joint,[11] has led to its widespread use as an adjunct to LA in various blocks.

Lee AR et al. investigated the use of magnesium sulphate added to bupivacaine in interscalene block and found that adding magnesium sulphate prolonged the block and reduced post-operative pain.[8] Al-Refaey et al.[9] did a blinded randomized controlled trial to show the effect of adding magnesium sulphate to bupivacaine in transversus abdominis plane block and got similar results.

But the role of magnesium as an adjunct to LA in Pecs block has not been established yet with respect to the quality, duration and dose required. In our study, the addition of magnesium to bupivacaine in a dose of 150 mg has led to lower VAS pain scores, prolongation of analgesia, less requirement of rescue analgesia.

In a previous study by Ibrahim and colleagues,[15] the authors have claimed a duration of 9 h with the use of magnesium in a dose of 500 mg in Pecs block, while literary research has established the role of magnesium even at lower doses. Thus, we used a lesser dose of magnesium sulphate based on the data from Gunduz and colleagues[16] who showed that the addition of magnesium sulphate in a dose of 150 mg provided a pronounced prolongation of the duration of sensory and motor blocks, without systemic or neurotoxicity.

Even, in our study we found that addition of magnesium to bupivacaine resulted in longer lasing and better quality of analgesia compared to control and a dose of 150 mg was equally effective with almost 10 h duration of analgesia and lesser postoperative VAS scores and lesser requirement of rescue analgesia consumption.

Our results are consistent with the results obtained by Elyazed and Mogahed,[17] who studied the effects of adding 150 mg MgSO$_4$ to 0.5% ropivacaine in infraclavicular block and observed significant prolongation of both sensorimotor block and duration of analgesia 598.71 ± 51.54 min similar to our study.

Thus, we concluded that a dose of 150 mg magnesium sulphate prolongs the duration of analgesia by almost 40% and results in better quality of analgesia with lesser requirement of rescue analgesic and better satisfaction scores.

**CONCLUSION**

Magnesium sulphate in a dose of 150 mg is effective in prolonging the duration of analgesia and improves quality of analgesia, when added as an adjunct to bupivacaine in ultrasound guided Pecs block.

**References**

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How to cite this article:
Dr Manjit Singh Kanwar, Dr Ankita Chandel and Dr Nisha Sharma.2020, Magnesium Sulphate as an Adjuvant To Bupivacaine in Ultrasound-Guided Pectoral Nerve Block in Patients Scheduled for Modified Radical Mastectomy Under General Anaesthesia. Int J Recent Sci Res. 11(01), pp. 36782-36785. DOI: http://dx.doi.org/10.24327/ijrsrc.2020.1101.4995

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