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Original Research Article

Evaluation of Ultrasound-Guided Erector Spinae Plane Block with a Combination of Ropivacaine 0.5% with Dexmedetomidine (1mcg/Kg) with Ropivacaine 0.5% Alone for Post-Operative Analgesia in Thoracic Surgeries

Saladi Venkata Akshay[1], Kumbha Gopi[1], Gajera Manthankumar Pravinbhai[1], Sandeep Rathore[2]

[1]Anaesthesia residents, Department of Anaesthesiology, Gandhi Medical College, Bhopal, Madhya Pradesh, India

[2]Assistant Professor, Department of Anaesthesiology, Gandhi Medical College, Bhopal, Madhya Pradesh, India

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Corresponding author: Dr. Sandeep Rathore

Conflict of interest: Nil

Abstract

Background: Dexmedetomidine can significantly prolong the efficacy of local anesthetics for nerve block, lessen post-operative pain, reduce the dosage of local anesthetics and opioids, and lessen adverse responses, according to several studies. Evidence is limited in India's setup.

Aims and Objectives: To evaluate the effect of dexmedetomidine co-administered with or without ropivacaine 0.5% for post-operative analgesia in thoracic surgeries.

Materials and Methods: Sixty patients (age: 30-75 years and body mass index: 18–25 kg/m^2) undergoing thoracic surgeries were randomly divided into Group R (n=30; patients who received ropivacaine 0.5% alone) and Group RD (n=30; patients who received a combination of ropivacaine 0.5% with dexmedetomidine (1mcg/kg). Intravenous compound general anesthesia was given and maintained, followed by an erector spinae plane **(**ESP) block. Onset time, block duration, and pain severity were recorded using a visual analog scale (VAS) scores at 0.5 h, 6 h, 12 h, 24 h, and 48 h postoperatively. The time taken to get out of bed for the first time and the length of post-operative hospital stay were also recorded. Quality of life score at 24 hours, the analgesia satisfaction of patients, and the occurrence of adverse reactions or complications were also recorded.

Results: The onset time was shorter for Group RD than for Group R ($P < 0.001$). The erector spinae muscle block duration was longer in Group RD than in Group R ($p<0.001$). Compared with Group R, the VAS scores at 6 h ($p<0.001$), 12 h ($p<0.001$), 24 h ($p<0.001$), and 24 h ($p<0.001$) postoperatively were significantly lower in Group RD, whereas at 0.5 h VAS score did not differ substantially between the groups ($p=0.572$). Compared with Group R, the QoR-40 score was significantly higher ($P < 0.001$), and the time taken to get out of bed for the first time and length of post-operative hospital stay was significantly shorter in Group RD ($P < 0.05$. No significant difference in terms of ESP block-related adverse reactions and complications were reported between the two groups ($p>0.05$).

Conclusion: Dexmedetomidine (1mcg/kg) as an adjuvant to 0.5% ropivacaine for ESP block is better than 0.5% ropivacaine alone for overall analgesia and post-operative rehabilitation of patients undergoing thoracic surgeries.

Keywords: Thoracic Surgeries, Erector Spinae Plane Block, Adjuvant Drugs, Dexmedetomidine.

Introduction

Video-assisted wedge resection is considered a widely accepted and effective method for treating early lung cancer. Advantages include small incisions, small trauma, and rapid recovery. Still, many patients undergoing surgery report moderate pain which gets aggravated during coughing. This affects the post-operative recovery of these patients. (Jian C 2022) [1,2]

Previous reports have shown that the erector spinae plane (ESP) block is safe for patients undergoing thoracic surgery. However, using a single local anesthetic to prolong the duration of post-operative analgesia is limited. (Shi L 2019) [3]

Dexmedetomidine, as an adjuvant, is found to prolong the effect of local anesthetics for nerve block, reduce post-operative pain, reduce the dosage of local anesthetics and opioids, and reduce adverse reactions. (Coviello A 2021) Few studies have reported dexmedetomidine's optimal concentration and dose ratio with the local anesthetic in ESP block. (Gao X 2021, Altıparmak B 2019) The present study attempts to evaluate the effect of dexmedetomidine co-administered with or without ropivacaine 0.5% for post-operative analgesia in thoracic surgeries. [4-7]

Materials and Methods

Present randomized controlled trial was performed in the Department of Anaesthesiology, Gandhi Medical College from January 2022 to January 2023 on 60 patients who underwent elective thoracic surgeries.

Those aged between 30-75 years, with body mass index 18–25 kg/m^2, and the American Society of Anesthesiologists grade of I–III were included. In contrast, patients with block site infection, coagulation dysfunction, history of an allergic response to local anesthesia, long-term use of anti-inflammatory and analgesic drugs during the recent 3 months, and severe cardiopulmonary, liver, kidney dysfunction and declined to participate were excluded from the present study.

Patients were randomly divided into Group R (n=30; patients who received ropivacaine 0.5% alone) and Group RD (n=30; patients who received a combination of ropivacaine 0.5% with dexmedetomidine (1mcg/kg).

Anesthesia methods

Intravenous compound general anesthesia (0.02–0.03-mg/kg midazolam, 0.2-mg/kg etomidate, 0.2–0.4-μg/kg sufentanil, and 0.15-mg/kg atracurium) was given to all the patients. Post nitrogen removal and oxygen supply (for 5 min), endotracheal intubation was performed. Anesthesia was maintained using intravenous infusion of propofol (50–80 μg.kg− 1. min− 1) and remifentanil (0.2–0.6 μg.kg− 1. min− 1). Hemodynamic stability was adjusted. Once the patient met the extubation indication, the endotracheal tube was removed. Patient-controlled intravenous analgesia was used postoperatively.

ESP block

All the patients underwent ESP block half an hour before general anesthesia induction. In the lateral position of the patient, the high-frequency linear ultrasonic probe was placed in the longitudinal sagittal direction at 3 cm outside the T5 spinous process. From the top to the bottom, it was easy to see the trapezius muscle, the rhomboid muscle, the erector spinae muscle, and the end of the T5 transverse process. Using the in-plane technique, local anesthetics were injected when the needle

tip was between the erector spinae muscle and the transverse process. Another anesthesiologist, who didn't know who was in which group, used acupuncture to measure the block plane 30 minutes after the block was done.

Outcome measures

Important outcome measures recorded included onset time, plane, and block duration. The severity of pain was evaluated using a visual analog scale (VAS) score at 0.5 h, 6 h, 12 h, 24 h, and 48 h postoperatively. The time taken to get out of bed for the first time and the length of post-operative hospital stay were also recorded. Quality of life score was obtained on follow-up at 24 hours using the QoR-40 questionnaire. The analgesia satisfaction of patients with post-operative analgesia was recorded on a scale of 0–100 points at 48 h postoperatively. Occurrences of adverse reactions or complications, such as respiratory depression, nausea and vomiting, hypotension, bradycardia, and local anesthetic toxicity within 48 h postoperatively, were recorded.

Data analysis

All the data analysis was performed using SPSS 25.0 (IBM Inc., New York, NY). The measurement data are expressed as mean ± standard deviation. Group comparison was done using analysis of variance (ANOVA). Chi-square (χ^2) test was used for between-group comparisons for proportions. The difference was statistically significant ($P < 0.05$).

Results

Table 1: Comparison of basics characteristics of the study population (n=60)

Characteristics	Group R (n=30)	Group RD (n=30)	P value
Age (years)	53.12 ± 4.47	54.18 ± 5.48	0.887
Gender (male/female)	18/12	17/13	0.721
Weight (kg)	61.46 ± 6.46	62.24 ± 7.43	0.578
BMI (kg/m^2)	22.12 ± 1.17	23.48 ± 1.66	0.728
ASA (I/II/III)	2/24/4	3/24/3	0.889

There was no significant difference in age, sex, weight, BMI, operation time, and ASA grade between the two groups (table 1).

Table 2: The level block of erector spinae muscle

Parameter	Group R (n=30)	Group RD (n=30)	P value
Onset time (min)	15.82 ± 1.18	12.48 ± 1.32	<0.001
Duration (h)	13.23 ± 2.37	16.27 ± 1.32	<0.001

The onset time was shorter for Group RD than for Group R (P < 0.001). The erector spinae muscle block duration was longer in Group RD than in Group R (p<0.001; Table 2).

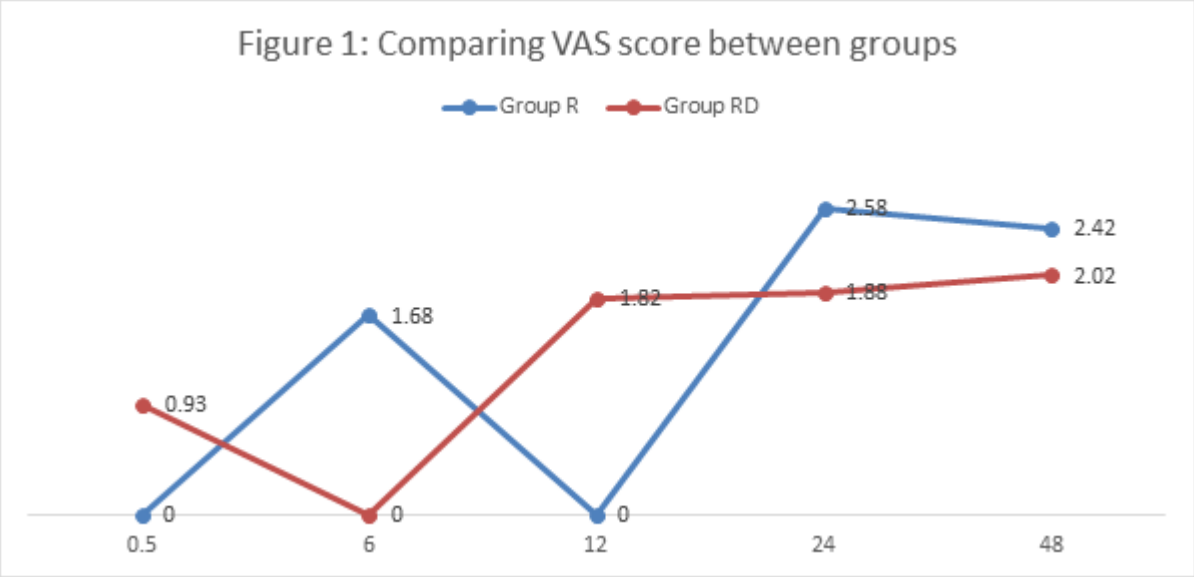

Figure 1: Comparing VAS score between groups

Compared with Group R, the VAS scores at 6 h ($p<0.001$), 12 h ($p<0.001$), 24 h ($p<0.001$), and 24 h ($p<0.001$) postoperatively were significantly lower in Group RD, whereas at 0.5 h VAS score did not differ substantially between the groups ($p=0.572$).

Table 3: Comparison of rehabilitation quality between the two groups

Parameter	Group R (n=30)	Group RD (n=30)	P value
Time taken to get out of bed for the first time (days)	1.42 ± 0.11	1.01 ± 0.09	<0.001
Length of post-operative hospital stay (days)	3.42 ± 0.19	2.65 ± 0.17	<0.001
QoR-40 scores	164.83 ± 2.68	178.12 ± 4.68	0.001
Analgesia satisfaction	83.24 ± 2.34	92.12 ± 3.62	<0.001

Compared with Group R, the QoR-40 score was significantly higher ($P < 0.001$), and the time taken to get out of bed for the first time and length of post-operative hospital stay was significantly shorter in Group RD ($P < 0.05$)(Table 3).

No significant difference in terms of ESP block-related adverse reactions and complications were reported between the two groups ($p>0.05$). In both groups, one patient experienced nausea and vomiting. One patient in Group R had bradycardia and one patient in Group RD had hypotension. There were no adverse reactions or complications, such as respiratory depression, infection, nerve injury, and local anesthetic toxicity.

Discussion

Present randomized study showed that ultrasound-guided dexmedetomidine combined with 0.5% ropivacaine for ESP block showed an excellent analgesic effect in patients undergoing thoracic surgeries. The overall post-operative analgesic effect and the rehabilitation quality of patients, the addition of dexmedetomidine to 0.5% ropivacaine is better as compared to 0.5% ropivacaine alone for ESP block. [8]

The dorsal and ventral branches of the thoracic spinal nerve can be completely blocked by ESP block. So, it has a wider range of blockage than the intercostal nerve. (Kot P 2019)

In clinical anesthesia, 0.2% levobupivaca - ine and 0.2–0.5% ropivacaine are the commonly used peripheral nerve block drugs. (Jian C 2022) Dexmedetomidine is a new type of high-selectivity α2

adrenoceptor agonist. It possesses sedative, analgesic, antianxiety, and antisympathetic properties, which are beneficial for the post-operative recovery of patients. Dexmedetomidine relieves pain by narrowing the blood vessels nearby and slowing local anesthetics' absorption. (Naaz S 2014, Gertler R 2001) Dexmedetomidine also directly affects the activity of peripheral neurons by acting on the adrenergic receptor (peripheral apparatus) to make the effects of local anesthesia last longer. Lastly, dexmedetomidine keeps the hyperpolarization potential of the cell membrane by blocking the hyperpolarization-activated cation current. This keeps the membrane potential from returning to the level it was at when the cell was resting. (Kosugi T 2010, Jian C 2022) [9,10]

In the present study, we found that ultrasound-guided dexmedetomidine combined with 0.5% ropivacaine for ESP block showed a good analgesic effect in patients undergoing thoracic surgeries. The overall post-operative analgesic effect and the rehabilitation quality of patients, the addition of dexmedetomidine to 0.5% ropivacaine is better as compared to 0.5% ropivacaine alone for ESP block. In line with that Gao et al. reported that a combination of dexmedetomidine (1 μg/kg) and 0.5% ropivacaine can prolong the ESP block time of patients undergoing thoracoscopy by approximately 120% (about 18 h). This was significantly longer than the ESP block performed by 0.5% ropivacaine alone. (Gao Z, 2019) Dexmedetomidine (1 g/kg) added to local anesthetics can significantly lengthen the time of the nerve block, stabilize intraoperative hemodynamics, lower the post-operative VAS score, and restrict the administration of post-operative analgesic medications, according to several other earlier studies. (Gao Z 2019, Kumari P 2020, Aksu R 2027, Manzoor S 2018) Reports of Vorobeichik et al showed that a 50–60-μg dose of dexmedetomidine could maximize the duration of sensory block and minimize hemodynamic side effects. None of the patients in the Vorobeichik et al. study reported any neurological sequelae with evidence of the high quality of sensory block. (Vorobeichik L 2017) Our findings support Vorobeichik et al. claims. [11-14]

In another study by Abdulatif et al., dexmedetomidine (50 μg and 75 μg doses) was used as an adjuvant. The study showed that a 50-μg dose of dexmedetomidine was associated with lesser time before post-operative morphine was needed, prolonged time to achieve sensory block, and the lesser time before the first rescue analgesia was administered. However, there were chances of hypotension with a 75 μg dose. (Abdulatif M 2016) However, in the present study, no significant difference in terms of ESP block-related adverse reactions and complications were reported between the two groups. In both groups, one patient experienced nausea and vomiting. [15]

Ultrasound-guided ESP block is a new fascial space block. It offers the advantages of simple operation, safety, a high success rate of block puncture, and few operation-related complications. (De Cassai A 2019) In the present study compared with Group R, the VAS scores at 6 h ($p<0.001$), 12 h ($p<0.001$), 24 h ($p<0.001$), and 24 h ($p<0.001$) postoperatively were significantly lower in Group RD whereas at 0.5 h VAS score did not differ substantially between the groups ($p=0.572$) indicating that the analgesic effect of the combination of dexmedetomidine with 0.5% ropivacaine was better than that of 0.5% ropivacaine alone. Appropriate post-operative analgesia is associated with greater comfort, reduced dosages of post-operative analgesics, early resumption of activities, reduced risk of pulmonary complications, and shorter hospital stays. (Gao Z 2019) [16]

QoR-40 is an effective patient-centered multidimensional quality assessment tool. (Gornall BF 2013) Myles et al. reported that an increase of 6.3 or more in the overall QoR-40 score represents a clinically

relevant improvement in the quality of post-operative recovery. (Myles PS 2016) Compared with Group R, the QoR-40 score in the present study was significantly higher ($P < 0.001$). These findings were attributed to the lower VAS score and better analgesia in Group RD.

The small sample size and limited research conditions are the main limitations of the present study. This study was a single-center study. The conclusion of the present study needs to be confirmed by large, multicenter randomized clinical trials. [17-19]

Conclusion

Dexmedetomidine (1mcg/kg) combined with 0.5% ropivacaine provided effective pain control postoperatively and reduced the need for rescue analgesia compared to ropivacaine 0.5% alone. It also more significantly improved the post-operative rehabilitation quality for patients undergoing thoracic surgeries.

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