Section: Anaesthesiology

Original Research Article

A COMPARATIVE STUDY TO ASSESS POSTOPERATIVE ANALGESIC EFFICACY OF DEXMEDETOMIDINE AS AN ADJUVANT TO ROPIVACAINE IN ULTRASOUND GUIDED BILATERAL SUPERFICIAL CERVICAL PLEXUS BLOCK FOR THYROIDECTOMY

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ABSTRAC

Background: In this era of day care surgery and opioid free anaesthesia, regional blocks play a significant role. Dexmedetomidine has been widely used as adjuvant to local anaesthetics in central as well as peripheral nerve blocks. This study was designed to evaluate efficiency of dexmedetomidine when combined with ropivacaine for superficial cervical plexus block (SCPB).
Materials and Methods: 60 patients scheduled for total thyroidectomy were given Ultrasound guided bilateral superficial cervical plexus block (BSCPB) after general anaesthesia. Group R received 8ml of 0.25% ropivacaine and Group RD received 8ml of 0.25% ropivacaine with 0.25mcg/kg dexmedetomidine on each side. The main objective was to determine if adding dexmedetomidine prolonged pain free period postoperatively. Other parameters assessed were Visual Analogue Scale (VAS) at 1, 2, 4, 6, 12 and 24 hours, post-operative analgesic consumption, hemodynamic profile and nausea-vomiting.
Results: Duration of analgesia was more in Group RD as compared to Group R (10.4 ± 2.29 hr vs 5.55 ± 2.52 hr). The VAS scores at 1, 2, 4, 6,12 hr were lower in group RD (p value <0.001) . No difference was observed at 24 hours. Total tramadol consumption in 24hours post-surgery was lower in Group RD (52.3 ± 28.1mg) as compared to Group R (93.3 ± 27.8mg).
Conclusion: Combining dexmedetomidine with ropivacaine increased the analgesic duration and decreased consumption of analgesics in the post-operative period.
Keywords: Thyroidectomy, Ropivacaine, Dexmedetomidine, Superficial Cervical Plexus Block

INTRODUCTION

Thyroidectomy is a day care surgery at many centres and good analgesia is one of the criteria for discharge. Tissue dissection, endotracheal tube movement during surgical manipulation and hyperextension of the neck are some of the factors that contribute to postoperative pain.[1] Nonsteroidal anti-inflammatory agents are known to predispose to postoperative oozing from the surgical site.[2] With an intent to minimise use of opioids, multimodal analgesia is widely practised. Regional nerve blocks are popular since they not only provide postoperative analgesia but also reduce the intraoperative requirement of maintenance agents. The SCPB has long been used to provide analgesia for procedures involving the neck region. Blockade of superficial cervical plexus results in anaesthesia

of only cutaneous branches.[3] Conventionally the landmark technique was used. However the advent of ultrasound has further reduced risk of complications. The amount of local anaesthetic used can also be reduced with USG, thus making the procedure safe. Ropivacaine although less cardiotoxic does not provide long duration of analgesia. A significant prolongation of duration of analgesia has been reported when dexmedetomidine is added to local anaesthetics for epidural, subarachnoid, caudal, paravertebral block and peripheral nerve blocks.[4] Dexmedetomidine with local anaesthetic drugs has been reported to be well tolerated without signs of neurotoxicity.[5] Amongst the other advantages is its antiemetic effect which may be induced through inhibition of catecholamines.[6]

The primary aim of this study was to evaluate and compare the duration of postoperative analgesia in patients who received SCPB with ropivacaine alone versus those who received ropivacaine in combination with dexmedetomidine. The secondary objectives were to compare the intraoperative hemodynamic parameters and Visual Analogue Scale (VAS), analgesic consumption along with the incidence of nausea-vomiting in the post-operative period.

MATERIALS AND METHODS

Institutional Ethics Committee approval was sought before initiating this prospective randomised trial (RegNo.ECR/465/Inst./MH/2013/RR-19, ECARP/2023/233). The conduct of the study was in alignment with the requirements of ethical principles of the Declaration of Helsinki. All ethical principles were strictly followed and patients were informed of all aspects of the study before acquiring consent. A total of 60 patients aged 25-60yr, ASA Class I/II, undergoing elective thyroidectomy and euthyroid at the time of surgery were included in the study. Patients excluded were those either hyper or hypothyroid at the time of surgery, history of hypersensitivity to the study drugs, pregnancy, coagulopathy, infection at the site of injection, large thyroid size preventing block administration, chronic analgesic use and psychiatric illness. All patients went through pre-anaesthetic evaluation, airway assessment, routine investigations and indirect laryngoscopy to confirm vocal cord mobility. The patients were explained in detail regarding the study procedure and the use of visual analogue scale for pain assessment. In the operating room standard ASA monitors were attached and baseline values of heart rate, non-invasive blood pressure and arterial oxygen saturation noted.

Patients were administered midazolam 0.03mg/kg and fentanyl 2mcg/kg. After preoxygenation, propofol 1-2mg/kg iv was used as the induction agent and endotracheal tube passed after giving vecuronium 0.08mg/kg. Anaesthesia was maintained with sevoflurane in a mixture of oxygen: air in a ratio 50:50 and intermittent boluses of vecuronium guided by the nerve stimulator. With the patient's head turned in the opposite direction, the high frequency linear transducer (4-12 MHz; Samsung Medison, SONOACE R7) was placed transversely over sternocleidomastoid muscle (SCM) at its midpoint (roughly at the cricoid cartilage level). Upon identifying the SCM, the transducer was moved until the tapering posterior edge was centred in the middle of the screen. The cervical plexus was identified as a cluster of hypoechoic nodules. The needle was advanced in-plane through the skin and platysma just under the tapering posterolateral edge of the SCM and above the levator scapulae muscle until the tip was visualised adjacent to the plexus. The spread of the injected local anaesthetic was observed on USG.

Patients were divided into two groups by means of a computer-derived random number table.

Group R- 8ml of 0.5% ropivacaine + 8ml of NS - total 16 ml of 0.25% solution (8ml on each side)

Group RD- 8ml of 0.5% ropivacaine + dexmedetomidine 0.25mcg/kg + NS to make total 16ml of 0.25% solution (8ml on each side)

Drug solution was prepared by an anaesthesiologist not involved in conducting the case. The anaesthesiologists who performed the block and monitored the patient in the postoperative period were blinded to the group allocation.

The parameters recorded during surgery were Heart rate (HR), Systolic, Diastolic, Mean Arterial Pressure (MAP), SpO2, End tidal CO2, Train of four count (TOF) and Minimum alveolar concentration (MAC). At the completion of surgery when the patient showed signs of recovery from neuromuscular blockade, neostigmine with glycopyrrolate was given to reverse residual effect of vecuronium. Extubation was carried out once the patient was fully awake and a train-of-four (TOF) ratio of 1 was confirmed. All patients in both groups were administered intravenous paracetamol 1g and ondansetron towards the end of the surgery.

Patients were transferred to the post anaesthesia care unit where pain was assessed at 1, 2, 4, 6, 12 and 24 hr using the VAS score. Rescue analgesia in the form of Tramadol (2mg/kg) iv was administered when VAS score was more than 3. The time from when the block was given until demand for rescue analgesia was recorded as the duration of analgesia. An Unpaired T-Test was used for comparing VAS scores and Analgesic consumption.

Nausea and vomiting were assessed using the PONV score, graded as follows: 1 indicating no nausea, 2 mild nausea, 3 severe nausea, and 4 retching and/or vomiting. Patients with a score of 3 or 4 were given metoclopramide iv as the rescue anti-emetic.

Sample size: Study by Kr Raiger L et al,[7] a power analysis based on the difference in the total post-operative analgesic consumption over 24 hr between two groups given SCPB with ropivacaine (416.33 mg)] versus ropivacaine with dexmedetomidine (370.00 mg) with an error of 0.05, power of study of

80%, and confidence limit of 95%, expressed that 27 patients in each group would be sufficient to detect a difference in total consumption of analgesics. Accounting for potential patient dropouts, the total sample size was set at 60, with 30 participants allocated to each group.

Categorical variables were presented in numbers and percentages and continuous variables as mean ± standard deviation (SD). To compare the change in the parameter at two different time intervals an unpaired t-test (for parametric data) and Mann-Whitney U-test (for non- parametric data) was used. The normal distribution of data was assessed by using the Shapiro-Wilk test. Qualitative variables were correlated using the Chi- square test. A p value of less than 0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics software, version 21 (IBM, New York, USA).

RESULTS

60 patients participated in this study [Figure 1] Both groups were well matched with respect to their demographic characteristics with no statistically significant difference in age, gender, ASA physical status [Table 1] While the baseline heart rate was comparable, patients in Group RD had lower values at the measured time intervals [Table 2] However, systolic, diastolic, and mean arterial pressures remained comparable between the two groups across all measured time intervals [Figure 2-4] The time to first rescue analgesia and total analgesic consumption over the first 24 hours were both statistically significant between the groups [Table 3] The number of patients needing rescue antiemetics was not significant. VAS scores were significantly lower in Group RD at 1, 2, 4, 6, and 12 hours postoperatively, with no significant difference observed between the groups at 24 hours [Table 4]

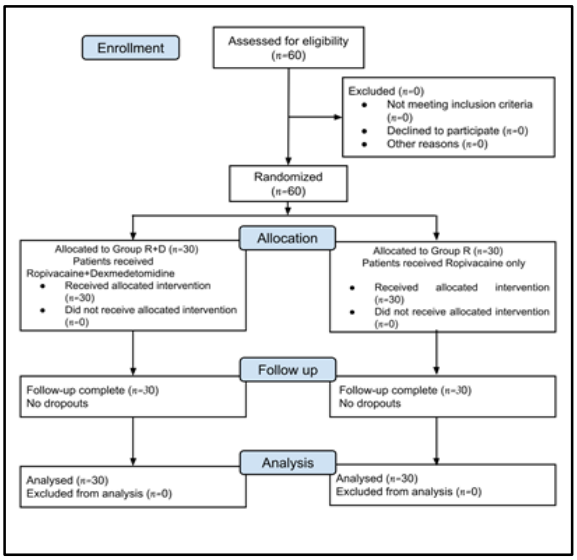

Figure 1: Consort flow chart of patient progress through the randomised trial

Table 1: Demographic profile and ASA Physical Status

Parameter	Group R	Group RD
Age(years) (Mean ± SD) p value	 41.9 ± 9.2 0.93	 41±7.72 0.44
Gender • Female • Male	 27 (45%) 3 (5.0%)	 24 (40%) 6(10%)
ASA PS I II	 14(23.3%) 13(21.7%)	 16(26.7%) 17(28.3%)

ASA PS- American Society of Anaesthesiologists Physical Status, SD-Standard deviation

Table 2: Comparison of intraoperative heart rate at different time intervals between the groups

Time (minutes)	Group R (Mean ± SD)	Group RD (Mean ± SD)	p value
0	86.90 ± 7.53	87.60 ± 7.84	0.726
30	85.70 ± 6.01	74.60 ± 7.10	<.001
60	85.40 ± 4.95	76.10 ± 9.63	<.001
90	84.30 ± 7.32	73.50 ± 7.19	<.001
120	85.30 ± 7.66	73.80 ± 7.49	<.001

Table 3: Post-operative outcomes

Parameter	Group R (Mean ± SD)	Group RD (Mean ± SD)	p value
Time to rescue analgesia(hours)	5.55 ± 2.52	10.4 ± 2.29	<.001
Amount of tramadol consumed in 24 hours (mg)	93.3 ± 27.8	52.3 ± 28.1	<.001
Number of patients who needed additional antiemetic medication	6	2	0.129

Table 4: Comparison of postoperative VAS scores at different time intervals between the groups

Time (hours) Postoperative	Group R VAS score (Mean ± SD)	Group RD VAS score (Mean ± SD)	p value
1	1.77 + 0.728	1.3 + 0.535	0.006
2	3.43 + 1.1	1.97 + 0.964	<.001
4	4.47 + 0.9	2.9 + 0.803	<.001
6	5.6 + 0.932	3.17 + 0.874	<.001

12	5.53 + 0.629	4.73 + 0.868	<.001
24	5.7 + 0.794	5.3 + 0.837	0.063

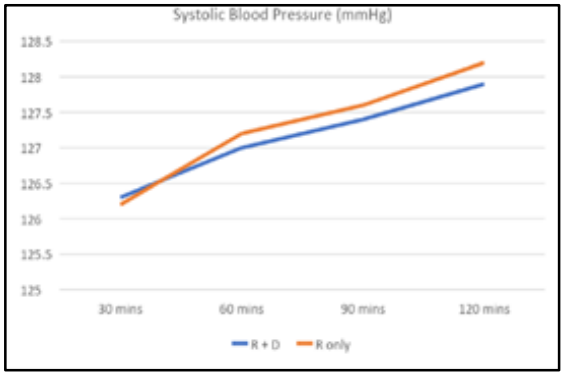

Figure 2: Comparison of systolic blood pressure between the two study groups at different time intervals.

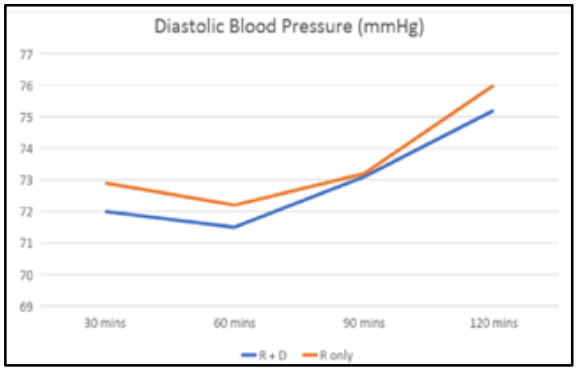

Figure 3: Comparison of diastolic blood pressure between the two study groups at different time intervals.

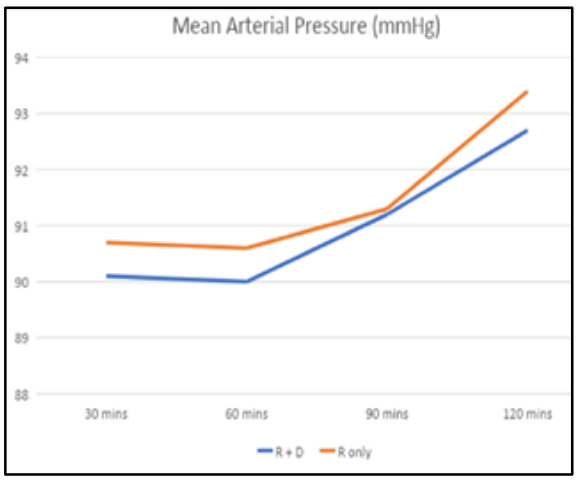

Figure 4: Comparison of mean arterial pressure between the two study groups at different time intervals.

DISCUSSION

This study found that dexmedetomidine when used as an adjunct to ropivacaine in SCPB for thyroidectomy, prolonged the duration of analgesia, reduced postoperative pain severity and analgesic consumption. Patients who received dexmedetomidine had lesser heart rates intraoperatively. The systolic, diastolic and mean arterial pressures were comparable to those who received only ropivacaine. Fewer patients in the dexmedetomidine group required antiemetics postoperatively.

Besides thyroid surgery, cervical plexus blocks have been found useful in transcatheter aortic valve implantation, clavicular fracture fixation, pacemaker and chemoport inversion, carotid endarterectomy and chest surgery with spontaneous breathing preservation.[8,9]

While the landmark technique was previously used, most centres use ultrasound when available to perform this block. With USG guidance it is possible to administer superficial, intermediate or deep cervical plexus block.[10] Senapathi et al,[11] found the Ultrasound superior to the landmark technique.

In this study the cervical plexus block was given with the help of ultrasound. Dexmedetomidine is one of the adjuvants that have been used along with local anaesthetics. It is advantageous as it provides opioid sparing analgesia, diminished sympathetic activity and sedation without causing respiratory depression. When used in peripheral nerve blocks, the sensory and motor inhibition is prolonged.[12] The adverse effects like bradycardia, hypotension and excessive sedation are mostly dose related.[13,14] This study used a low dose of 0.25mcg/kg of dexmedetomidine. Wang et al while studying the impact of its toxicity on nerves found that higher doses of 3µg/ml were associated with damage but 1 and 2 µg/ml were not neurotoxic in rabbits.[15]

Dexmedetomidine contributes to the effect of local anaesthetics by inhibiting the potassium and sodium channel to maintain the hyperpolarized state of the cells.[16,17] Dexmedetomidine's effect on sensory block is more obvious than motor. This is probably because it blocks unmyelinated C fibres carrying pain and small A-δ myelinated fibres responsible for temperature and pain sensation than the large myelinated motor fibres.[18]

Santosh et al,[19] administered 20 mL of 0.5% ropivacaine along with dexmedetomidine at a dose of 0.5 µg/kg SCPB, which extended the duration of postoperative pain relief and greater levels of patient satisfaction. However, it did not alleviate the pain of swallowing. Lin administered 0.375% ropivacaine with 1µg/kg dexmedetomidine in SCPB for thyroidectomy. The patients remained sedated but arousable, however the heart rate and mean arterial pressure decreased after the procedure.

Lin et al reported that the time taken to achieve sensory block onset was significantly reduced (4.72 ±1.1 min vs 6.64 ±1.2 min) with 1mcg/kg dexmedetomidine combined with 0.375% ropivacaine (30 ml).20 We could not assess onset of block since it was performed after administering general anaesthesia. They further observed that the

Ramsay sedation scores recorded at 5, 10, 20, 40, 60, 90, and 120 minutes following local anaesthetic injection were notably elevated in the dexmedetomidine group. We did not compare sedation scores. Santosh et al,[19] reported no statistically or clinically meaningful alterations in intraoperative mean arterial blood pressure or heart rate when 20 mL of 0.5% ropivacaine was combined with dexmedetomidine at a dose of 0.5 mcg/kg. The current study used 0.25mcg/kg dexmedetomidine and found significant reduction in heart rate at 30, 60, 90 and 120min after block. It did not however need any intervention. When dexmedetomidine was used in a dose of,[1] mcg /kg, significant reduction in haemodynamic parameters has been reported by Swami et al.[2] This study did not find significant differences in either systolic, diastolic or mean arterial pressures in group RD. Mostafa et al observed a greater number of hypotensive episodes among patients in the dexmedetomidine group; however, this difference did not reach statistical significance.[22]

Elshayeb M et al found significantly lower heart rates up to 8 hours postoperatively who underwent superficial combined with intermediate cervical plexus block using 20 ml of bupivacaine 0.25% along with 50 µg of dexmedetomidine on each side.[23] They also found that patients first needed rescue analgesia between 12 and 20 hours (median score of 16 hr) when 100mcg dexmedetomidine was added to bupivacaine versus 4 to 12 hr (median score of 8 h in the control group.

The present study similarly found that the time to first analgesic dose was extended from 5.55 ± 2.52hr in the control group to 10.4 ± 2.29hr when dexmedetomidine was added to ropivacaine. Santosh et al reported that the addition of dexmedetomidine to ropivacaine almost doubled the duration of analgesia.19 However, they used 0.5% ropivacaine as compared to the current study where 0.25% ropivacaine was used. The RD group demonstrated significantly reduced VAS scores at 2, 4, 6, and 12 hours postoperatively. They were comparable at 1hr and 24 hr postoperatively. Santosh et al observed that VAS pain scores were comparable between groups up to 6 hours, but were notably lower at 12 and 24 hours in the dexmedetomidine group. The total amount of tramadol(mg) consumed over 24hr postoperatively was significantly less in group RD (52.3 ± 28.1) versus (93.3 ± 27.8) in group R. These findings are comparable with those of Santosh et al who used 0.5µg/kg of dexmedetomidine as well as Elshayeb et al who used 100 µg of dexmedetomidine. Our study achieved similar prolongation of analgesia with a lower dose of dexmedetomidine (0.25mcg/Kg).

Santosh and Mehendale,[19] documented pain on deglutition after thyroidectomy which was not taken care of by the SCPB. However, it lasted only 3-5 hr post-extubation and patients did not demand additional analgesics. Some studies have reported that BSCPB failed to reduce analgesic consumption following thyroid surgery.[24,25] This study would probably have been more conclusive with a third group that did not receive SCPB. Shih et al,[26] demonstrated that the addition of BSCPB to general anaesthesia led to a reduction in the incidence of postoperative nausea and vomiting following parathyroid and thyroid surgery. Elshayeb et al found no statistically significant difference between the two groups with regard to postoperative complications, including nausea, vomiting, hoarseness of voice, and hematoma formation. In the present study, 2 patients in the RD group and 6 patients in the R group required antiemetics, though this difference did not reach statistical significance. In a meta-analysis, Liang X et al reported that a bolus dose of 0.5 µg/kg dexmedetomidine was adequate in preventing nausea, while a higher dose of 1.0 µg/kg was required to reduce the occurrence of vomiting.[27] The mechanism by which dexmedetomidine has an antiemetic effect is not clear. This may be attributed to reduced noradrenergic activity resulting from binding to α2 presynaptic inhibitory adrenoceptors in the locus coeruleus.[28] It is known that intraoperative opioids affect the degree and frequency of nausea and vomiting. Consumption of opioids is reduced when dexmedetomidine is used.[29,30]

The limitations of this study are non-inclusion of a control group in whom SCPB was not given. We did not study sedation scores and block related complications.

CONCLUSION

The addition of dexmedetomidine to ropivacaine in bilateral superficial cervical plexus blocks prolonged the duration of analgesia and led to a significant reduction in analgesic consumption in post-operative period. Thus, adding dexmedetomidine to ropivacaine enhances the effectiveness of bilateral superficial cervical plexus block compared to using ropivacaine alone. The use of ultrasound guidance further allows for lower volumes of local anesthetic and dexmedetomidine, while enhancing safety by reducing complications.

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