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CLINICAL & BASIC RESEARCH

Effect of Erector Spinae Block and Pectoralis Block on Quality of Recovery and Analgesia After Modified Radical Mastectomy

A randomised controlled study

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abstract: ***Objectives:*** Post-operative pain after a modified radical mastectomy ranges from moderate to severe. Pectoralis (PECS) block has been found to be more effective than erector spinae block in reducing pain and the consumption of rescue analgesia in the post-operative period. This study aimed to compare the effect of erector spinae block and PECS block on the quality of recovery after modified radical mastectomy using the quality of recovery (QoR-40) score. ***Methods:*** This randomised controlled study was conducted at King George's Medical University, Lucknow, India, from 9th October 2020 to 9th October 2021. After general anaesthesia, patients were given blocks according to computer-generated randomisation: Group I: PEC I and PEC II (PECS) blocks; Group II: erector spinae plane (ESP) block; and Group III: control group (no intervention). The QoR-40 score was observed on the morning of the surgery and after 24 hours. Time to rescue analgesia and the total consumption of rescue analgesia in the first 24 hours were also observed. ***Results:*** A total of 90 patients were included (30 in each group). In the post-operative period after 24 hours, global QoR-40 scores were 183.64 ± 6.36, 179.68 ± 6.38 and 171.37 ± 6.88 in the PECS, ESP and control groups (P <0.0001). But there was no statistically significant difference between the QoR scores of PECS and ESP group patients (P = 0.0551). The total requirement of rescue analgesic was significantly lower in the PECS group (137.28 ± 31.46 mg) than in the ESP (189.46 ± 42.98 mg) and control (229.57 ± 46.80 mg) groups (P <0.0001). Time to first rescue analgesia was significantly higher in the PECS group (6.53 ± 2.78 hours) than in the ESP (4.05 ± 2.91 hours) and control (2.15 ± 1.51 hours) groups (P <0.0001). ***Conclusion:*** Both ESP and PECS blocks were effective in improving the QoR score and in reducing the consumption of rescue analgesia after modified radical mastectomy.

Keywords: Cancer; Mastectomy; Postoperative Pain; Post-Operative Recovery; India.

Advances in Knowledge

- *Both erector spinae block and pectoralis block show very promising results in providing post-operative analgesia after breast surgery. This study helped the authors obtain more data and knowledge about analgesic efficacy of both these blocks as well as their effect on quality of recovery after MRM.*

Applications to Patient Care

- *These blocks provide post-operative analgesia which results in patients being more comfortable post-operatively, having better general overall well-being and better post-operative outcomes.*

As of 2020, female breast cancer is the most commonly diagnosed cancer worldwide.[1,2] Radical or modified radical mastectomy (MRM) is the main treatment option for locally advanced lesions of breast.[3] MRM is usually performed under general anaesthesia. The rate of incidence of severe post-operative pain on the first post-operative day after MRM is almost 60%.[4] Poor management of pain in the post-operative period may lead to various acute and chronic detrimental effects.[5,6] Therefore, adequate control of pain in the post-operative period is very important to alleviate these detrimental effects. Furthermore, access to adequate pain management is the fundamental right of every patient.[7] Moreover, adequate control of pain in the post-operative period can also have an impact on the recovery quality of patients.[8] The quality of recovery (QoR-40) score is a global score for assessing the status of recovery after anaesthesia and surgery. It includes 40 questions covering five domains: patient's psychological support, emotional status, physical comfort, physical independence in doing their work and the severity of pain. In a number of surgical settings, the QoR-40 score has been shown to be a valid and sensitive method for measuring the dynamic and multidimensional process of post-operative recovery.[9–11] Nair *et al*. reported that patients who received regional blocks during breast surgery had higher post-operative QoR scores.[11] Yao *et al*. also observed that preoperative erector spinae (ESP) block improves the post-operative QoR score and post-operative analgesia in patients undergoing MRM.[12] Furthermore, Sinha C *et al*. compared the

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pectoralis (PEC) and ESP blocks after MRM and observed that patients with PEC II block had lower pain scores and consumption of analgesics in the post-operative period compared to those with the ESP block.[13] Therefore, it was hypothesised that PEC I and PEC II (PECS) block patients would also have better quality of recovery compared to those with ESP block. The current study aimed to compare the effects of ESP and PECS blocks on the post-operative quality of recovery after MRM using the QoR-40 score; the QoR-40 score was compared 24 hours after surgery. In addition, this study aimed to determine the total consumption of analgesics in the first 24 hours, time to rescue analgesia, post-operative visual analogue scale (VAS) score and comparison of intraoperative haemodynamic variables.

Methods

This randomised controlled study was conducted at King George's Medical University, Lucknow, India, from 9th October 2020 to 9th October 2021. It included female patients aged 18–60 years with American Society of Anaesthesiologists grade I/II and who were planned for a unilateral MRM for breast cancer. Patients who refused to participate in the study and those with endocrine disorders (including diabetes mellitus types I and II), any coagulation disorders, cognitive inability to understand QoR-40 questionnaire and allergies to local anaesthetics were excluded.

Patients were assessed for eligibility and randomly allocated to one of the following three groups using computer-generated random numbers: Group I: PECS block; Group II: ESP block; and Group III: control group [Figure 1]. The QoR-40 score was noted on the morning of surgery for each patient. The patients were taken in the operation theatre and monitored for heart rate, blood pressure ([BP] including systolic BP [SBP], diastolic BP [DBP] and mean arterial pressure [MAP]), oxygen saturation (SpO_2) and electrocardiogram. Subsequently, an intravenous (IV) line was inserted in the arm contralateral to the surgery planned and IV fluid was started. Preoxygenation was done for 3 minutes, followed by an injection of fentanyl (1 µg/kg) and an injection of propofol (2–2.5 mg/kg); after checking for adequate bag and mask ventilation, an injection of vecuronium (0.1 mg/kg) was given. After 3 minutes, either a second-generation supraglottic airway device or an endotracheal tube was inserted. Following confirmation of adequate ventilation through auscultation and capnography, the patients were put on volume-controlled ventilation mode. Anaesthesia was maintained with O_2:N_20 (50:50) and sevoflurane. After that, the patients received respective blocks according to randomisation.

The blocks were performed using a Stimuplex® needle A100 (0.80 × 100 mm [21G × 4"]; B Braun, Pennsylvania, USA) and a Toshiba ultrasonogram machine with a high-frequency linear probe (38 mm, 6–13 MHz; Toshiba ,Tokyo, Japan). Hydro dissection (saline) was used to identify the correct position and plane before injecting the local anaesthesia.

For the PECS block, the patient was positioned supine, with the arm ipsilateral to the surgery site abducted to 90°. The skin was prepared with 10% betadine solution, following which the sterile ultrasonography (USG) probe was put longitudinally at the mid-clavicular level just below the clavicle and was adjusted to identify the axillary artery and vein. The caudal edge of the probe was then turned laterally and the USG probe was moved downwards to identify the third rib, the fourth rib, the pectoralis major muscle, the pectoralis minor muscle and the serratus anterior muscle. The needle was introduced through an in-plane technique from the cranial edge of the probe and advanced to lie in the interfascial plane between the pectoralis minor and the serratus

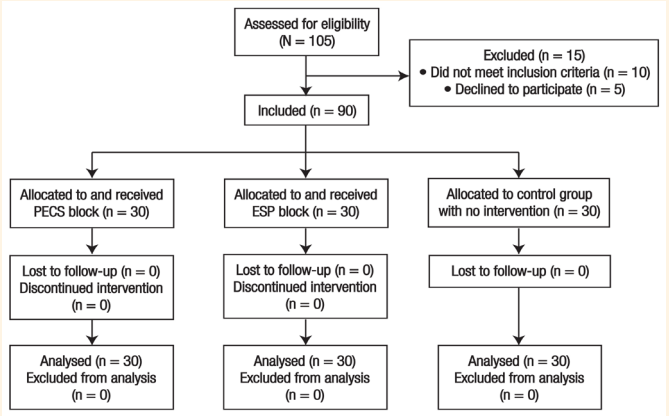

Figure 1: Flowchart showing selection process for this study.

Table 1: Characteristics of patients after modified radical mastectomy using different nerve blocks (N = 90)

Characteristic	Group I: PECS group (n = 30)	Group II: ESP group (n = 30)	Group III: Control group (n = 30)	F and *P* value
Age in years ± SD	43.52 ± 9.6	42.26 ± 7.64	44.13 ± 8.9	F = 0.3563 *P* = 0.7013
Weight in kg ± SD	59.4 ± 9.1	57.2 ± 5.28	56.71 ± 8.1	F = 1.048 *P* = 0.3551
Height in cm ± SD	162.6 ± 7.6	159.0 ± 46.5	156.21 ± 3.9	F = 0.4132 *P* = 0.66283
BMI in kg/m² ± SD	22.5 ± 3.8	23.9 ± 3.6	22.0 ± 3.1	F = 1.118 *P* = 0.21963
ASA I:II	24:6	26:4	25:5	X = 0.48 *P* = 0.7866
Duration of anaesthesia in minutes ± SD	86.8 ± 18.1	89.4 ± 19.4	87.7 ± 17.5	F = 0.1553 *P* = 0.8564

PECS = pectoralis I and II; ESP = erector spinae; SD = standard deviation; BMI = body mass index; ASA = American Society of Anesthesiologists.

Table 2: Mean global quality of recovery scores of groups I–III patients

Global QoR-40	Group I: PECS group (n = 30)	Group II: ESP group (n = 30)	Group III: Control group (n = 30)	F and *P* value
Pre-op score ± SD	186.63 ± 7.78	185.53 ± 6.73	186.34 ± 7.56	F = 0.1795 *P* = 0.8360
		*P = 0.8322, †P = 0.9873, ‡P = 0.9051		
At 24 hours post-operation score ± SD	183.64 ± 6.36	179.68 ± 6.38	171.37 ± 6.88	F = 27.47 *P* <0.0001
		*P = 0.0551, †P <0.0001, ‡P <0.0001		

QoR-40 = quality of recovery score (0–200); PECS = pectoralis I and II; ESP = erector spinae; SD = standard deviation.
**Group I versus Group II. †Group I versus Group III. ‡Group II versus Group III.*

Table 3: Time to first rescue analgesic requirement and total rescue analgesic in first 24 hours post-modified radical mastectomy

	Group I: PECS group (n = 30)	Group II: ESP group (n = 30)	Group III: Control group (n = 30)	F and *P* value
Time to first rescue analgesics requirement in hours ± SD	6.53 ± 2.78	4.05 ± 2.91	2.15 ± 1.51	F = 23.5 *P* <0.0001
		*P = 0.0006, †P <0.0001, ‡P = 0.0108		
Total rescue analgesics requirement in mg in first 24 hrs ± SD	137.28 ± 31.46	189.46 ± 42.98	229.57 ± 46.80	F = 38.34 *P* <0.0001
		*P <0.0001, †P <0.0001, ‡P = 0.0008		

PECS = pectoralis I and II; ESP = erector spinae; SD = standard deviation.
**Group I versus Group II; †Group I versus Group III; ‡Group II versus Group III.*

Table 4: Mean visual analogue scale score of groups I–III patients

VAS score ± SD	Group I: PECS group (n = 30)	Group II: ESP group (n = 30)	Group III: Control group (n = 30)	F and *P* value
At 1 hour	0 ± 0	0 ± 0	0 ± 0	-
At 2 hours	0 ± 0	0 ± 0	0 ± 0	-
At 4 hours	0.52 ± 0.37	0.54 ± 0.82	0.59 ± 0.21	F = 0.1371 *P* = 0.8721
At 6 hours	1.04 ± 0.19	2.01 ± 0.54	4.13 ± 1.45	F = 92.48 *P* <0.0001
At 12 hours	1.44 ± 0.54	2.28 ± 0.90	4.80 ± 1.09	F = 120.2 *P* <0.0001
At 24 hours	2.10 ± 1.14	3.41 ± 1.19	4.94 ± 1.95	F = 27.9 *P* <0.0001

VAS = visual analogue scale; SD = standard deviation; PECS = pectoralis I and II; ESP = erector spinae.

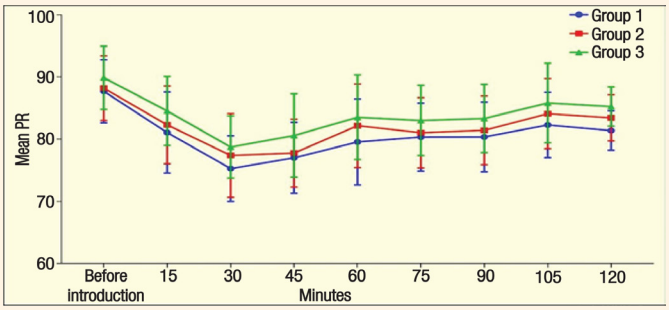

Figure 2: Mean pulse rate in beats per minute between groups I–III patients.

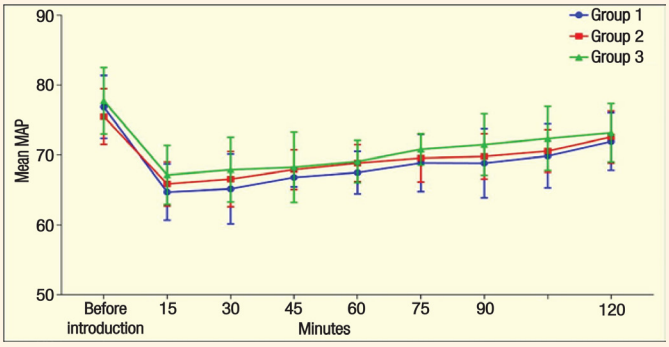

Figure 3: Mean arterial pressure in mm of Hg between groups I–III patients

anterior muscles, and 20 mL of 0.25% bupivacaine was administered (PECS II). After giving the PECS II block, the needle was withdrawn slowly and adjusted to lie between the pectoralis major and minor muscles, and after confirmation by hydro dissection, 10 mL of 0.25% bupivacaine was deposited there (PECS I).

For the ESP block, the patient was placed in the lateral decubitus position, and following aseptic precautions, a sterile USG probe was put longitudinally paramedian to the thoracic spine and a T4 transverse process was identified. Superficial to the transverse process, erector spinae, rhomboid major and trapezius muscles were identified. The needle was introduced using an in-plane cephalocaudal approach till the needle tip came in contact with the transverse process. After confirmation of the correct plane by hydro dissection, 20 mL of 0.25% bupivacaine was given superficial to the transverse process and beneath the erector spinae muscle.

This study was double blinded so neither the patients nor the observer who observed the patient and collected the data were aware of the interventions received by patients. Approximately 30 minutes before completion of surgery, each patient was given paracetamol 1 g IV and thereafter 1 g IV after every 6 hours. If any patient had a VAS score >3 in the post-operative period, rescue analgesic injection of tramadol (100 mg) IV was given. The time duration between two injections of tramadol was kept at >4 hours. Haemodynamic variables (heart rate, MAP, SBP, DBP and SPO_2) were recorded every 15 minutes from before surgery until completion of surgery. Time to rescue analgesia and the total consumption of rescue analgesia in the first 24 hours were also observed. The QoR-40 score was observed again after 24 hours. QoR-40 questionnaires were completed by the observer who verbally translated the questionnaire into the regional language for the patients.

The sample size was calculated on the basis of the pilot study done on 10 patients in which the standard deviation (SD) was 7.12 for QoR-40 in the control group. Assuming a difference of 10 would be clinically significant, the minimum sample size was calculated to be 28 in each group. A total of 30 patients allocated to each group with the possibility of loss to follow-up. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS), Version 15.0 (IBM Corp., Chicago, Illinois, USA). The continuous variables were evaluated by mean ± SD. The dichotomous variables were presented in numbers and analysed using Chi-square or Fisher's exact test. To compare the means between two groups and three groups, Student t-test and analysis of variance, respectively, were conducted. A P value <0.05 was considered to be statistically significant.

Approval for the study was obtained from the institutional ethical committee registration (no: ECR/262/Inst/UP/2013//RR-19, Ref,code: 102nd

ECM II BThesis/P64) and this study was registered in a clinical trial registry (CTRI/2020/12/029933). Written informed consent was obtained from all patients. This study adhered to the Helsinki declaration and CONSORT recommendations.

Results

A total of 90 patients were included in this study. All the groups exhibited comparable demographic profiles [Table 1]. On comparing the mean average global QoR-40 (0–200) score preoperatively, no statistically significant difference between the three groups was observed (P = 0.8360). At 24 hours, there was a significant difference between three groups, as the global QoR-40 (0–200) score was the highest in the PECS group followed by the ESP group and the control group. The difference between the three groups was statistically significant (P <0.0001) but no significant difference was found between the PECS and the ESP groups (P = 0.0551) [Table 2].

The requirement of rescue analgesic was significantly lower in the PECS group than in the ESP and the control groups (P <0.0001). Time to first rescue analgesic was found to be significantly higher in the PECS group than in the other two groups [Table 3].

A gradual increase in the VAS score was observed in all three groups after surgery. The VAS score was the lowest in the PECS group. The difference between the groups was statistically significant after 6 hours, 12 hours and 24 hours [Table 4].

There was no significant clinical difference in the haemodynamic variables in the three groups intraoperatively [Figures 2 and 3].

Discussion

Following MRM, patients report moderate to severe post-operative pain; various drugs and regional analgesic techniques are used for providing post-operative pain relief. Opioids are the most commonly used drugs for post-operative analgesia but their use in cancer patients is associated with suppression of cellular immunity and increase in cancer recurrence.[14] Non-steroidal anti-inflammatory drugs (NSAIDs) are another class of drugs commonly used for post-operative analgesia, but their efficacy is limited to mild to moderate pain. Also, a high incidence of post-operative nausea and vomiting has been found in patients with MRM, and the use of opioids and NSAIDs may increase the incidence of postoperative nausea and vomiting.[15] Transdermal patch is a non-invasive method of providing post-operative analgesia and has been found to be very effective in reducing pain scores in the post-operative period in various other surgeries. But transdermal patches generally contain opioids and NSAIDs, which can again increase the incidence of nausea and vomiting after MRM surgery. So, regional analgesia is the best modality for providing post-operative analgesia in MRM patients. Furthermore, it has also been found that using regional analgesia decreases the incidence of chronic pain.[16]

Overall, thoracic epidural and paravertebral blocks are still gold standard regional analgesic techniques.[17–19] But sometimes it may be difficult to give thoracic epidural and paravertebral blocks, as they are also associated with complications such as pneumothorax, vascular puncture or nerve injury. Hence, there is always a need to find alternatives to these blocks, which are easy to give, have a higher safety profile and can provide equivalent pain relief. Both PECS and ESP are the blocks that are easy to perform and have very few complications when administered by an expert. They also reduce the requirement of analgesia in the post-operative period and decrease the pain scores.[20,21]

The quality of recovery of any patient after surgery may be related to the quality of perioperative analgesia. In their study, Myles *et al.* observed that the patient's quality of recovery after anaesthesia and surgery can be assessed effectively by using the QoR-40 score.[10]

In our study, after 24 hours the global QoR-40 score was 183.64 ± 6.36 in the PECS group, 179.68 ± 6.38 in the ESP group and 171.37 ± 6.88 in the control group, and the inter mean difference between groups was statistically significant after 24 hours with a global QoR-40 (0-200) score (P <0.0001). However, the difference between the PECS group and the ESP group was statistically insignificant. Kamiya *et al.* studied the effect of PECS block on post-operative pain and the QoR score in breast cancer surgery patients and observed that the pain score in the PECS group was lower than that in the control group until 24 hours.[22] But they found no statistically significant difference between the requirement of rescue analgesic and the QoR-40 score. In our study, a significant difference in the requirement of rescue analgesic and the QoR score between PECS and control groups was observed. This difference may be due to Kamiya *et al.* having injected the drug deep to the *serratus* anterior muscle for PECS II block, while in the current study, the drug was administered superficial to the *serratus* anterior muscle.

In a study conducted by Yao *et al.* it was found that the ESP block improves the pain QoR score in the post-operative period.[12]

Similar to the current study, Sinha *et al.* also observed that the PECS block administered prior to MRM leads to a decrease in the requirement of post-operative analgesics in the first 24 hours. The mean duration of analgesia was 7.26 ± 0.69 hours in patients with the PECS block and 5.87 ± 1.47 hours in individuals with the ESP block.[13] Altıparmak *et al.* also observed that the PECS group patients had a lower consumption of tramadol in the post-operative period. In their study, the consumption of tramadol was 132.78 ± 22.44 mg in the PECS group and 196 ± 27.03 mg in the ESP group (P = 0.001).[23] Gad *et al.* also observed that patients in the PECS group had a lower consumption of morphine in the post-operative period compared to those with the ESP block.[24]

Regarding complications, no procedure-related complications were encountered in any of the groups, which is similar to other studies.

The major limitation of this study was that the original version of the QoR-40 score was used, which is in English; the score was completed by a clinician who verbally translated it into the regional language and this might have affected the interpretation of the score. Other limitations of this study include the small sample size and the single-centric approach. Another limitation was that the block was given after inducing the patients so the level of sensory block could not be assessed.

Conclusion

Both ESP and PECS blocks were effective in improving the post-operative quality of recovery after modified radical mastectomy when compared with the control group. In the PECS block group, time to first rescue analgesic was higher and the requirement of rescue analgesic was less compared to the ESP block group. As this study is single-centred, a multicentric study with a large sample size is required for generalisability of results.

AUTHORS' CONTRIBUTION

Collection of data and drafting of the manuscript was done by MHM. Analysis and interpretation of data were handled by MHM and RV. RV, H, DS, SS and KS contributed to the concept and design as well as the critical revision of the manuscript. All authors approved the final version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interests.

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