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Original Research Article

Thoracic fascial planes blocks in operative bed of modified radical mastectomy and their role in alleviating post-mastectomy pain: a prospective randomized study

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ABSTRACT

Background: Proper pain management after modified radical mastectomy is crucial for improving postoperative outcomes, reducing tumor recurrence, enhancing anti-metastatic activity and achieving excellent patient`s satisfaction. Thoracic fascial planes (TFP) blocks are novel, and safe analgesia modalities to control postmastectomy pain. This study was designed to assess the efficacy and safety of intraoperative TFP blocks for providing postoperative analgesia after modified radical mastectomy.
Methods: During the period from March 2020 to April 2021, 30 females (ages 25–67 years) were scheduled for elective MRM and selected randomly to one of two groups; group-A included 15 patients who underwent MRM and anesthetized with both general anesthesia and regional anesthesia (TFP blocks), group-B included 15 patients who underwent MRM and anesthetized with only general anesthesia.
Results: The group-A had statistically significantly lower pain scores. The time of first rescue nalbuphine dose post-operatively was statistically significantly longer in group-A compared to group-B. The total 24h nalbuphine consumption and postoperative non-steroidal ketorolac requirements/48h were significantly lower in group-A compared to group-B. Satisfaction score in group-A was statistically significantly better than that in group-B.
Conclusions: Intraoperative thoracic fascial planes blocks are simple, safe, and highly effective analgesic modalities after breast surgery.

Keywords: Modified radical mastectomy, Fascial planes blocks, Nerve blocks, Pain control, Postmastectomy pain, PECS I and II blocks

INTRODUCTION

Modified radical mastectomy (MRM) with axillary dissection is the mainstay of management of locally advanced breast cancer.[1] Acute postoperative pain is the foremost distressed adverse event of this surgery.[2] Around 10–20% of patients subjected to inappropriate acute pain control; experience postmastectomy pain syndrome (paresthesia, phantom breast pain, and neuralgia).[3] In turn, the selection of proper analgesia modalities can considerably improves the surgery outcomes, reduces its complications and achieves excellent patient`s satisfaction.[4] Proper postmastectomy pain control has been postulated to be effective in increasing levels of IL-10 and enhancing cytotoxicity of natural killer cells; displaying anti-tumour and anti-metastatic activity.[5,6] Multimodal pain therapy approaches such as neuraxial techniques [thoracic

epidural or thoracic paravertebral block] and opioids can be used to control postmastectomy pain.[2] However, these techniques are associated with serious morbidities including intrathecal spread, nerve damage, epidural hematoma, and inadvertent intravascular injection.[7] Thoracic fascial planes (TFP) blocks (pectoral nerves (PECS I, II) and serratus anterior plane (SAP) blocks) are novel ultrasound-guided regional anesthesia approaches of the thorax, that are easier, safer, and more practical alternatives to neuraxial techniques in patients undergoing MRM.[8] Conventionally, thoracic fascial planes (TFP) blocks are administered preoperatively and require an ultrasound and an expert anesthetist to identify the precise planes and avoid intravascular injection with consequences of local anesthetic toxicity, and avoid hematoma formation.[9] The present study investigated the efficacy and safety of the thoracic wall fascial planes blocks in the operative bed of MRM surgery, when the nerves are clearly visible to overcome the traditional fascial planes blocks limitations.

Objectives

This study was designed to assess the efficacy and safety of intraoperative thoracic fascial planes blocks for providing postoperative analgesia after modified radical mastectomy and assess the postoperative opioids and non-steroidal analgesic requirements.

METHODS

During the period from March 2020 to April 2021, 30 females (ages 25–67 years) with stage 2 and 3 breast cancer; presented to the General Surgery Department, Benha University Hospital. Patients were scheduled for elective MRM and selected randomly to one of two groups; group-A included 15 patients who underwent MRM and anesthetized with both general anesthesia and regional anesthesia (TFP blocks), group-B included 15 patients who underwent MRM and anesthetized with only general anesthesia. The study was approved by the ethics committee of Benha Faculty of Medicine; Benha University. All patients provided written informed consent before study enrollment. The variables assessed were age, breast cancer stages, operative time, duration of hospital stay, postoperative non-steroidal ketorolac tromethamine analgesic (30 mg/2 ml) dose/48 h, time of the first rescue nalbuphine HCl dose post-operatively, 24H nalbuphine HCl consumption (mg), postoperative nausea and vomiting (PONV), satisfaction score (poor = 0, fair = 1, good = 2, excellent = 3). The severity of postoperative pain was assessed at 1h, 3h, 6h, 12h, 24h, 48h by NRS; numeric rating scale 0-10; whereas (0) indicated no pain and indicated worst pain. All parameters were recorded with an independent surgeon not contributing in the study.[10]

Study design

This was a prospective randomized controlled study.

Inclusion criteria

Age >25 years. Breast cancer stages 2 and 3. Patients tolerated general and regional anaesthesia.

Exclusion criteria

Patient refusal. Serious neurological or psychiatric disorders. Allergy or any contraindication to local anesthetic and opioids. Known bleeding and coagulation disorders.

Operative procedure

Patient was placed in a supine position with extended ipsilateral arm. The breast, chest wall, axilla, and upper arm and neck were prepped and draped. An elliptical incision incorporating the nipple-areola complex and biopsy scar was done.

Figure 1: PECS I block.

Figure 2: PECS II block.

Figure 3: Serratus anterior plane block.

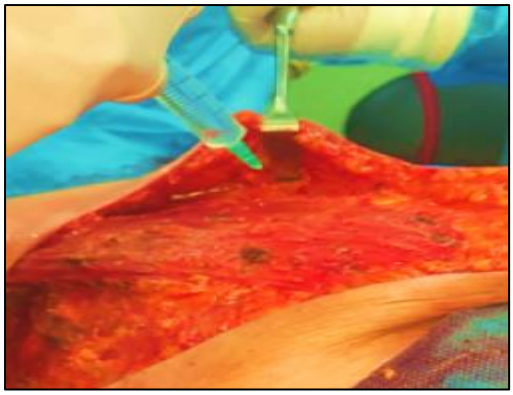

Figure 4: Parasternal plane block.

The flaps were raised between the subcutaneous tissue and the breast tissue: superiorly to the clavicle, medially to the sternum, laterally to the latissimus dorsi muscle, and inferiorly to the anterior rectus sheath. The breast tissue was dissected from medial to lateral, including the pectoralis fascia with specimen. Dissection under the pectoralis major and minor muscle was undertaken with preservation of the pectoral neurovascular bundle. The axillary vein was then identified and the axilla was cleared of nodal tissues and fat. The thoracodorsal and the long thoracic nerves were identified and preserved. The wound was irrigated and hemostasis was done. The patients in the group-A received regional blocks; pectoral nerve block type 1 (PECS I), and type 2 (PECS II), serratus anterior plane (SAP) block, and parasternal plane (PSP) block were undertaken. PECS I was performed by injection of 10 ml of 0.25% bupivacaine in the fascial plane between the pectoralis major and minor muscles (Figure 1), whereas PECS II was accomplished by injection of an additional 10 ml of 0.25% bupivacaine in the fascial plane between the pectoralis minor and serratus anterior muscles at the level of the third rib (Figure 2). An additional 20 ml of 0.25% bupivacaine was administered between the serratus anterior and latissimus dorsi muscles at the level of fifth rib (Figure 3). The parasternal plane block was done by blockade of the anterior branches of the intercostal nerves (T2–6) by injection of 10 ml of 0.25% bupivacaine in intercostal spaces 2, 3, 4 parasternally (Figure 4). The wound was closed with interrupted 3-0 Vicryl over two drains followed by a subcuticular layer. After the general anesthesia recovery; every patient received dose of 30 mg of ketorolac. The patient was shifted to the postanesthesia care unit. Pain intensity was noted down using NRS (1–10) at 1, 3, 6, 12, 24 and 48h. A dose of 30 mg of ketorolac was administered when a NRS score >4 and 10 mg nalbuphine when a NRS score >5. The total analgesic needed during the first 48h after the operation was documented.

Statistical analyses

Software (SPSS, Version 26.0 for Windows, SPSS Inc, Chicago, IL) was used for the univariate, bivariate, and stratified analyses of the data. Qualitative variables were analyzed by constructing contingency tables with Pearson x2 test or Fisher exact test, when conditions for the former were not met. The Student t test and Mann-Whitney U test were applied for the comparison of quantitative variables after establishing their normal distribution by means of the Shapiro-Wilk test and Levene test for equality of variance. Differences were considered significant at $p \leq 0.05$.

RESULTS

During the period from March 2020 to April 2021, 30 females were included in the present study.

Table 1: Comparison between the studied groups regarding the patients' demographic data, and the surgery outcomes.

		Group A (15)	Group B (15)	Statistical test	P value
Age (years)	Mean±SD	42.4±14.57	46.07±11.52	St t= 0.76	0.45
Breast cancer stage	**N (%)**	**N (%)**	**N (%)**		
2		10 (66.7)	6 (40.0)	X^2= 2.14	0.14
3		5 (33.3)	9 (60.0)		
Duration of surgery	Mean±SD	64.0±13.65	67.33±11.16	St t=0.73	0.47
Hospital stay	**N (%)**	**N (%)**	**N (%)**		
24 h		14(93.3)	10 (66.7)	FET= 3.23	0.17
48 h		0 (0.0)	1 (6.7)		
48 h		1 (6.7)	4 (26.7)		
Satisfaction score	**N (%)**	**N (%)**	**N (%)**		
Poor		0 (0.0)	1 (6.7)	FET= 21.53	<0.001**
Fair		1 (6.7)	6 (40.0)		
Good		2 (13.3)	8 (53.3)		
Excellent		12 (80.0)	0 (0.0)		

Table 2: Comparison between the studied groups regarding nalbuphine doses and ranges of consumption.

		Group A (15)	Group B (15)	Statistical test	P value
Time of first nalbuphine dose **3h** **6h** **12h**	N (%)	0 (0.0) 1 (33.3) 2 (66.7)	15 (100) 0 (0.0) 0 (0.0)	FET= 13.17	0.001**
NRS 1H	Median, IQR	0.0,0.0-0.0	3.0,3.0-4.0	Z= 4.93	<0.001**
NRS 3H	Median, IQR	0.0,0.0-2.0	7.0,7.0-8.0	Z= 4.74	<0.001**
NRS 6H	Median, IQR	3.0,2.0-4.0	6.0,6.0-7.0	Z= 4.66	<0.001**
NRS 12H	Median, IQR	4.0,3.0-4.0	5.0,5.0-6.0	Z= 3.53	<0.001**
NRS 24H	Median, IQR	4.0,4.0-4.0	4.0,4.0-4.0	Z= 0.98	0.33
NRS 48H	Median, IQR	3.0,2.0-3.0	3.0,3.0-4.0	Z= 2.06	0.04*
Post-op NS	Median, IQR	90.0,60.0-120.0	180.0,150.0-180.0	Z= 4.63	<0.001**
24h nalbuphine HCL consumption (18) **10** **20** **30**	N (%)	2 (66.7) 1 (33.3) 0 (0.0)	3 (20.0) 5 (33.3) 10 (66.7)	FET= 3.04	0.15
Post-op nausea and vomiting	N (%)	1 (6.7)	4 (26.7)	FET= 0.96	0.33

They were divided equally into two groups; group-A included 15 patients who underwent MRM and anesthetized with both general anesthesia and regional anesthesia (TFP blocks), group-B included 15 patients who underwent MRM and anesthetized with only general anesthesia. The mean age of group-A (±SD) was 42.4±14.57 years, and that of group-B was 46.07 ±11.52 years. No significant differences were found between both groups regarding breast cancer stages and duration of MRM operation. The group-A had statistically significantly lower median pain scores at 1, 3, 6,12h ($p<0.001$) but there were no significant differences at 24 h ($p=0.33$) and 48h ($p=0.04$) between both groups. The time of first rescue nalbuphine dose post-operatively was statistically significantly longer in group-A compared to group-B ($p<0.001$). Postoperative non-steroidal ketorolac tromethamine analgesic (30 mg/2ml) requirements/48h were significantly lower in group-A compared to group-B.

The total 24h nalbuphine consumption in the group-A was significantly lower than that in the group-B. Postoperative nausea and vomiting (PONV) were lower in group-A (6.7%) than that in group-B (26.7%). Satisfaction score in group-A was statistically significantly better than that in group-B ($p<0.001$ for all comparisons).

DISSCUION

Acute postmastectomy pain management has been evolved during the last decade. Many novel thoracic fascial planes (TFP) blocks have been introduced as alternatives to neuraxial techniques (epidural and thoracic paravertebral blocks), with advantages of overcoming their drawbacks like sympathetic block, pneumothorax, hypotension, spinal cord injury, epidural hematoma, and intravascular injection.[2] Thoracic fascial planes (TFP) blocks include pectoral nerves blocks (PECS I, II), serratus anterior plane (SAP) block, and parasternal plane (PSP) block.[8,10] The PECS I is injection of local anesthetic in the fascial plane between the pectoralis major and minor muscles at the level of the 3rd rib aiming at blockade of medial and lateral pectrol nerves (C5,6,7,8,T1). The PECS II is a modification of PECS I which includes PECS I in addition to another injection between the pectoralis minor and the serratus anterior at the level of the 4th rib to block pectoral nerves and lateral cutaneous branches of intercostal nerves (T2-6). The serratus plane block is injection of local anesthetic in the plane between the serratus anterior and lattissimus dorsi muscles at the 5th rib in order to block intercostal nerves (T3-9), long thoracic nerve (C5,6,7), and thoracodorsal nerve (C6,7,8).[11] The limitation of these three blocking methods is inability to block anterior cutaneous branches of the thoracic intercostal nerves (T2-6). Therefore, they cannot offer sufficient analgesia throughout the entire breast tissue.[2] In the present study, in order to provide adequate analgesia to the whole breast; we added to the previous blocking methods, the parasternal plane (PSP) block to block the anterior cutaneous branches of the intercostal nerves (T2–6). The limitations of these fascial nerve blocks that they are administered preoperatively, guided by ultrasound and require expert anesthetists otherwise inadvertent intravascular anesthetic injection, toxicity, and hematoma are consequences.[9] To overcome these limitations, we provided the present study through injection of local anesthetic in the fascial planes in the

operative bed of MRM while the nerves are clearly identified. In this study; thirty female patients presented by breast cancers stage 2 (53.33%) and stage 3 (46.66%). They were divided into two groups; group-A (test group), included 15 patients subjected to MRM and anesthetized by both general and regional anesthesia (thoracic fascial planes blocks); and group-B (control group), included 15 patients subjected to MRM and anesthetized by only general anesthesia. The objective of this study was to assess the efficacy of thoracic fascial plane (TFP) blocks in alleviating acute postmastectomy pain. The group-A had significantly lower median pain scores at 1, 3, 6,12h ($p<0.001$) in comparison to control group, but there were no significant differences at 24 h ($p=0.33$) and 48h ($p=0.04$) between both groups. Therefore, the total postoperative ketorolac tromethamine analgesic (30 mg/2 ml) requirements/48h and 24h nalbuphine consumption in the group-A were significantly lower than that in the group-B. Postoperative nausea and vomiting (PONV) were lower in group-A (6.7%) than that in group-B (26.7%) owing to less consumption of nalbuphine. PONV was treated by ondansetron 4 mg IV. We used nalbuphine instead of morphine because the analgesic efficacy of nalbuphine is approximately equivalent to that of morphine and the adverse effects like respiratory depression and postoperative nausea and vomiting are lesser with nalbuphine in comparison with morphine.[12] Satisfaction score in group-A was statistically significantly better than that in group-B ($p<0.001$ for all comparisons). That because the patients experienced low pain scores, no PONV, and short hospital stay. Several studies stated that a combination of general anesthesia and thoracic fascial planes blocks in breast surgeries are more effective analgesic modalities.[2,13,14] Zhao et al in their meta-analysis based on randomized controlled trials to evaluate the analgesic efficacy of the PECS block after radical mastectomy, they concluded that the PECS block can efficiently decrease the postoperative opioids consumption, postoperative PONV, and the requirement for rescue analgesia after MRM surgery.[15] Datu, and Prasetyadhi demonstrated that serratus anterior plane (SAP) block offered longer analgesic effect with lower opioid consumption and significantly lower pain scores in the postoperative period.[3] Although several studies emphasized the analgesic efficacy of PECS II and SAP blocks after breast surgeries, some criticized the analgesic effect of PECS I, because the PECS I blocks selectively the lateral pectoral nerve and some perforating branches of medial pectoral nerve which are motor nerves.[16,17] The analgesic effect of PECS I is attributed to relieve the pain resultant from pectoral muscles trauma and spasm.[18] Finally, understanding thoracic wall and breast innervation is crucial to achieve proper analgesia to entire breast tissue after MRM. PECS and SAP blocks are effective analgesic modalities for surgeries of the axilla and the lateral portion of the breast not the medial portion; because those procedures cannot block the anterior cutaneous branches of the thoracic intercostal nerves (T2-6) which innervates medial portion of the breast. These branches can be blocked by parasternal plane (PSP) block approach. Traditionally, thoracic fascial planes (TFP) blocks are performed by expert anesthetist, ultrasound-guided to identify fascial planes and avoid intravascular anesthetics injections. Intraoperative TFP blocks can easily performed without the aforementioned limitations after MRM in operative bed while the fascial planes and the nerves are clearly visible.

Limitations of the study

Our study had two main limitations. First, our study included only 30 patients; a further high-powered study with more patients is required to confirm our results and benefits of these nerve blocks. Second, our study focused on short term outcomes of the thoracic fascial planes blocks, a further study should be implemented to assess long term effects of those nerve blocks on chronic post-mastectomy pain.

CONCLUSION

Intraoperative thoracic fascial planes blocks are simple, safe, and highly effective analgesic modalities after breast surgery. They offer less postoperative opioids and non-steroidal analgesic consumptions, less PONV, and lower pain scores.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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