Erector spinae plane block for breast oncological procedure as a surrogate to general anaesthesia: A retrospective study

INTRODUCTION

In India, one of the most common cancers among women is carcinoma breast (25%–32%).[1] General anesthesia (GA) is the preferred technique for breast oncological procedures, but due to lack of residual analgesia, it is usually associated with inadequate pain control leading to the development of post-mastectomy pain syndrome (PMPS).[2] It also limits the range of movement of the ipsilateral arm with consequent development of frozen shoulder, thereby affecting the overall quality of life. Shoulder mobilization in immediate post-operative period improves the dynamics of shoulder joint movement by decreasing the muscle guarding, improving the blood and lymphatic flow thereby reducing the inflammatory cytokines. Thus, early physiotherapy or shoulder mobilization after breast surgery has been advocated as a mandatory part of postoperative rehabilitation. This becomes even more significant with increasing age as elder patients are often affected with various with joint diseases and impairment of bone mineralization, as a result of which even brief period of immobilization can lead to frozen shoulder.

Additionally, various other complications such as nausea, vomiting, pulmonary complications and depressed immune system,[3] etc., necessitate the use of an alternate technique. Several regional anesthesia techniques have been described for breast oncological procedures. These include local infiltration of wound, thoracic epidural anesthesia, thoracic paravertebral block and interfascial plane blocks such as serratus anterior plane block, pectoral nerve (PECS) block. Advantage of regional anesthesia includes effective peri-operative analgesia, reduced opioid consumption, lesser postoperative incidences of nausea and vomiting, fewer pulmonary complications, early mobilization, and discharge, and a significant reduction in progression of malignancy. However, all of them fail to provide complete surgical anesthesia and thus cannot be used alone to avoid the complications related to general anesthesia, especially in cardio-pulmonary compromised patients. The erector spinae plane block provide effective visceral and somatic analgesia for breast oncological procedures.[4] In this retrospective study, we analyzed the efficacy of erector spinae plane block against the conventional GA approach.

SUBJECTS AND METHODS

Ethical approval was provided by the Institutional Ethics Committee (reference number MGMCH/IEC/JPR/2018/16). In this retrospective study, the data of all the patients who had undergone a modified radical mastectomy either under conventional GA or erector spinae plane block with MAC (monitored anesthesia care) sedation at our center from January 2018 to August 2019 were collected and reviewed from the hospital database and medical records. Collected data included demographic information, anesthesia technique (either GA alone or erector spinae plane block with MAC sedation), details of intraoperative hemodynamic monitoring, postoperative pain score, analgesic consumption, postoperative complications, and other descriptive data about ease of initiation of physiotherapy, enteral feeding, and discharge.

The primary outcome measure was to compare the probability of development of frozen shoulder by evaluating the shoulder mobility of the affected side.

Shoulder mobility was assessed throughout the first three postoperative days using a "Shoulder Mobility Score (SMS)" (a composite score designed by the Khemka R *et al*.[5])

The secondary outcome measures included probability of development of post-mastectomy pain syndrome (PMPS) which was evaluated by pain scores recorded via visual analogue scale (VAS) score (0 = no pain and 100 = worst possible pain) both at rest and on the movement of the ipsilateral upper limb at various time intervals throughout the first three postoperative days, considering the time of arrival to the recovery after surgery as 'time 0'. Analgesic was considered when VAS ≥40.

As per the institutional protocol, post-MRM pain management included intravenous diclofenac 75 mg administration for first postoperative day and oral diclomol (diclofenac 50 mg + paracetamol 325 mg) from the second postoperative day. If a patient was unable to control the pain, backup analgesia (tramadol 100 mg intravenously) was considered after consulting an anesthesiologist.

Intraoperative hemodynamic changes (tachycardia, denoted by a heart rate >100 bpm; bradycardia, a heart rate <60 bpm; hypotension, defined as a 20% or more decline in baseline blood pressure, and hypertension, a 20% or more increment in baseline blood pressure) were compared at various time-points (at first surgical incision, 30 minutes post-incision, 1 hour post-surgical incision and at end of surgery).

Postoperative nausea and vomiting (PONV) was measured on a 4-point scale (no nausea, mild nausea, moderate to severe nausea and vomiting) for the first postoperative day considering the time of arrival to the recovery after surgery as 'time 0'. Ability to tolerate fluids without nausea and vomiting were recorded considering the time of arrival to the recovery after surgery as 'time 0'. Patients were discharged from the hospital after meeting the discharge criteria of the hospital which included no evident active medical or surgical complications and ability to tolerate oral fluids without nausea and vomiting and adequate pain relief with oral medication

Erector spinae plane block with MAC sedation technique:

As per the standard protocol of our institute, patients having surgery under ESP block were taken to a monitored regional block room for the performance of the ESP block. Before the procedures, all necessary equipment for GA and resuscitation were kept ready to deal with any case of block failure or complication. Standard monitoring like pulse rate, noninvasive blood pressure (NIBP), and peripheral arterial oxygen saturation (SpO2) was connected. Before ESP block, intravenous fentanyl (1 mcg/kg) was given in the block room to reduce the anxiety and discomfort during the procedure while maintaining meaningful patient contact. All patients received erector spinae plane block in sitting position. Using ultrasound, the probe was placed in a longitudinal orientation lateral to the thoracic fourth spinous process. Then, trapezius, rhomboideus major and erector spinae muscles were identified from the surface. Using a 22 gauge needle a total of 25 ml local anesthetic (0.5% bupivacaine with dexamethasone 8 mg) was injected between erector spinae muscle and T4 transverse process with intermittent aspiration. The spread of injectate was seen on ultrasound. After completion of the block procedure, the patient was made to lie supine with all the monitoring connected and was observed for the attainment of loss of pin-prick sensation in dermatomes from T1 to T8. After the achievement of loss of sensation to pin-prick in T1 to T8 on the operating side, the patient was shifted to the operating room. A minute before the first surgical incision, intravenous bolus dose of fentanyl 1 mcg/kg was given and intravenous propofol infusion was started to titrated between 25 mcg/kg/min to 75 mcg/kg/min to maintain moderate sedation (a state where patient responds to verbal commands, either alone or accompanied by light tactile stimulation) with oxygen supplementation with nasal prongs at the rate of 4 liters per minute. Propofol infusion was continued until the application of the first suture and oxygen supplementation with nasal prongs was discontinued after the application of the last suture.

Conventional GA approach

As per the standard protocol of our institute, patients having surgery under conventional GA were premedicated with intravenous (iv) midazolam (0.05 mg/kg), iv ondansetron (0.1 mg/kg) and iv fentanyl (2 mg/kg). The anesthesia was induced with iv propofol (2 mg/kg) followed by iv atracurium (0.5 mg/kg) to facilitate tracheal intubation. Maintenance of anesthesia was achieved with nitrous oxide 66% and oxygen 33%. The patients received topups of iv atracurium (0.1 mg/kg) at regular intervals and iv fentanyl (1 mg/kg) at 1 hour intervals if the surgery extended beyond 1-hour. At the end of the surgery, all patients were reversed from muscle relaxation with iv myopyrolate 5 ml.

Statistical analyses

Statistical analysis with the SPSS, version 21 for Windows statistical software package (SPSS inc., Chicago, IL, USA) was performed. The Categorical data were given as numbers (percent) and were compared using the Chisquare test among groups. The quantitative data were presented as mean and standard deviation and were co pared by students' ttest. Probability if less than 0.05 was considered to be significant.

RESULTS

Data for 139 patients were analyzed. Of these, 19 were excluded because the data (including demographic information, details of intraoperative hemodynamic monitoring, postoperative pain score, analgesic consumption, postoperative complications, and other descriptive data about ease of initiation of physiotherapy, enteral feeding, and discharge.) were incomplete. Of the remaining

120 patients, 57 received only ESP block with MAC sedation (Group: ESP), whereas the other 63 received only general anesthesia (Group: GA) The groups were comparable in terms of age, weight, height or ASA grading with each other [Table 1]. Shoulder mobility at arm flexion and arm abduction was significantly better in group ESP as compared to group GA at all time-points. Although the difference was progressively narrower it remained statistically significant [Table 2].

The VAS pain scores at rest as well as on movement of the ipsilateral arm [Table 3a and b], and subsequent analgesic consumption in the group ESP were low at all the time points for up to three postoperative days in comparison to the group GA. The difference consistently remained statistically significant. In Group ESP, the requirement for analgesic over 3 postoperative days was found to be reduced significantly in comparison to group GA. For the first 24 hours postoperatively, none of the patients of the ESP group required analgesic while 2, and 3 doses of analgesic were required by 27 and 36 patients, respectively, in group GA (average number of analgesic dose = 3). For the second postoperative day, a single dose of analgesic was required by 2 patients of group ESP while 2, and 3 doses of analgesic were required by 9 and 54 patients respectively in group GA (average number of analgesic dose = 3). For the third postoperative day, 14 patients of group ESP demanded a single dose of analgesic while 1, 2, and 3 doses of analgesics were required by 16, 19, and 28 patients, respectively, in group GA (average number of analgesic dose = 2) [Figure 1a].

Intraoperatively, group ESP patients showed stable haemodynamics (in terms of heart rate and mean blood pressure) at various time-points, throughout the duration of surgery when compared to the group GA [Figure 1b and c].

PONV scores were lower in the group ESP at all the time points, and the difference was statistically significant until 12 hours postoperatively [Table 4a]. 47 patients (82.4%) of group ESP tolerated enteral feeds within 4 h after surgery while 17.5% patients tolerated oral feeds within 8 h post-surgery. In group GA the earliest that someone tolerated oral feeds was around 12 h [Table 4b].

Majority of the patients of group ESP (57.8%) were discharged by day 4 of surgery, while 40.3% of group GA were discharged by day 8 of surgery. The earliest that someone in group ESP was discharged was by day 3 of surgery versus day 7 of surgery in group GA [Table 4c].

Table 1: Demographic data

Characteristics	Group: ESP (*n*=57)	Group: GA (*n*=63)	*P*
Age (years)	41±16.3	38±13.9	0.2789
Weight (Kg)	72±26.8	71.2±22.9	0.8604
Height (cm)	152.4±14.7	149.35±13.9	0.2452
ASA grade (I/II/III)	12/35/10	9/38/16	0.6060

ESP – Erector spine plane, GA – General anesthesia, *n* – Number of patients, ASA – American society of anesthesiologists

DISCUSSION

We found that shoulder mobility with ESP block was far better than GA alone at all time-points by using

Table 2: Shoulder Mobility Score

Time-point	Group: ESP (*n*=57)			Group: GA (*n*=63)			*P*
	Arm Flexion	Arm Abduction	Total	Arm Flexion	Arm Abduction	Total	
POD 1							
PACU	4	4	8	5	5	10	<0.0001
1 hr post-op	2	4	6	5	5	10	<0.0001
4 hr post-op	2	2	4	5	5	10	<0.0001
8 hr post-op	2	2	4	4	5	9	<0.0001
12 hr post-op	0	2	2	4	5	9	<0.0001
24 hr post-op	0	0	0	4	4	8	<0.0001
POD 2							
30 hr post-op	0	0	0	3	4	7	<0.0001
36 hr post-op	0	0	0	2	3	5	<0.0001
42 hr post-op	0	0	0	2	3	5	<0.0001
48 hr post-op	0	0	0	1	3	4	<0.0001
POD 3							
54 hr post-op	0	0	0	1	2	3	<0.0001
60 hr post-op	0	0	0	1	1	2	<0.0001
66 hr post-op	0	0	0	0	1	1	<0.0001
72 hr post-op	0	0	0	0	1	1	<0.0001

ESP – Erector spine plane, GA – General anesthesia, *n* – Number of patients, POD – Postoperative day, PACU – Post-anesthesia care unit

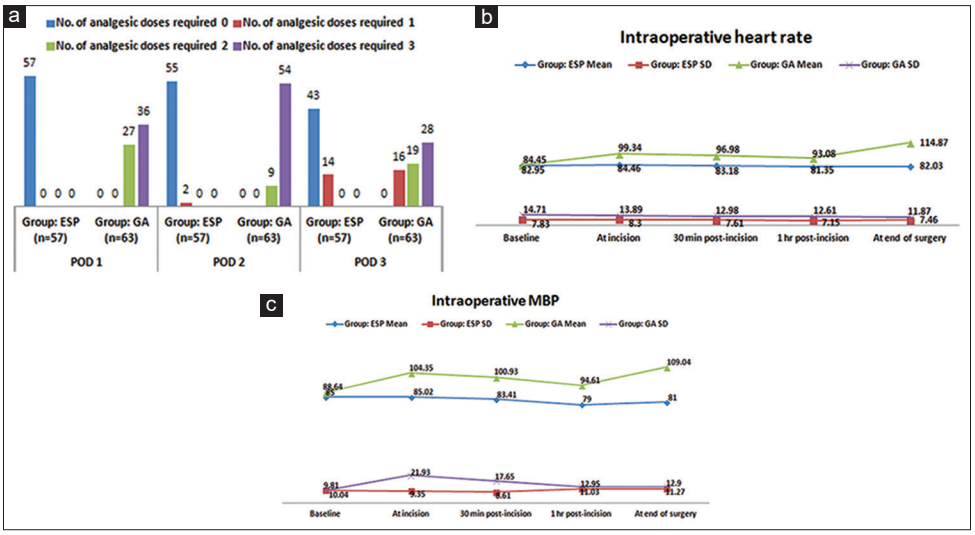

Figure 1: (a) Number of analgesic doses required over three postoperative days. ESP: erector spine plane, GA: general anesthesia. (b) Comparison of heart rate at different time interval in between groups. ESP: erector spine plane, GA: general anesthesia, SD: standard deviation. (c) Comparison of mean blood pressure at different time interval in between groups. ESP: erector spine plane, GA: general anesthesia, MBP: mean blood pressure, SD: standard deviation

shoulder mobility score devised by Khemka R *et al*.[5] Therefore, our study results showed that there was less probability of development of frozen shoulder with ESP block.

Shoulder mobilization after breast surgery is a mandatory part of postoperative rehabilitation. Patients have limited shoulder mobility due to pain and muscle guard leading to ineffective lymphatic drainage and development of lymphedema in the long term. In the elder population and patients with joint diseases, a brief period of immobilization can lead to frozen shoulder.[6]

Along with reduced probability of development of frozen shoulder, the probability of post-mastectomy pain syndrome was also minimal as the ESP block group had significantly reduced pain scores and postoperative analgesic requirements all through the three postoperative days. We observed a drastic 100% reduction in analgesic consumption and demand with ESP block in the first 24 hours postoperatively. Also, the analgesic requirement over the next 2 postoperative days was found to be minimal with only 3.5% and 24.5% patients demanding analgesic at second and third postoperative day, respectively. A similar profound analgesic quality of ESP block has been proved in several other studies also. Swati Singh *et al*.,[7] and Gurkan *et al*.[8] reported 85% and 65% reduction in opioid supplement requirement with ESP block, respectively.

Additionally, ESP block has also been reported to reduce adverse cardiac events peri-operatively by significantly reducing the stress imposed by the anesthesia and surgery. In our analysis, no evident perioperative adverse cardiac event was observed with any patient of the ESP block group. Furthermore, ESP block with MAC sedation provided adequate surgical anesthesia as depicted by far stable hemodynamic (heart rate and mean blood pressure) trends without any evident complication throughout the surgery, in comparison to the general anesthesia alone where vivid hemodynamic swings were observed as expected generally due to tracheal intubation and extubation. Kimachi *et al*.[9] first reported a case of effective and complete surgical anesthesia achieved with an ESP block. They reported the patient being comfortable and hemodynamic stable throughout 2.5 hours of surgical duration.

Table 3a: VAS at rest

Time interval (post-surgery)	Group: ESP		Group: GA	
	Median	IQR	Median	IQR
0 min	0	0	10	0
30 min	0	0	10	0
60 min	0	0	10	20
90 min	0	0	30	0
2 hr	0	0	30	20
3 hr	0	0	10	0
6 hr	0	0	10	10
12 hr	0	0	20	10
18 hr	0	0	10	10
24 hr	10	0	20	10
30 hr	10	0	30	0
36 hr	10	0	30	10
42 hr	10	10	20	10
48 hr	10	0	20	10

VAS – Visual analogue scale, ESP – Erector spine plane, GA – General anesthesia, IQR – Interquartile range

Table 3b: VAS at movement of ipsilateral arm

Time interval (post-surgery)	Group: ESP		Group: GA	
	Median	IQR	Median	IQR
0 min	0	0	10	0
30 min	0	0	10	10
60 min	0	0	20	10
90 min	0	0	30	10
2 hr	0	0	40	30
3 hr	0	0	10	10
6 hr	0	0	20	10
12 hr	0	0	30	10
18 hr	10	10	20	0
24 hr	10	0	20	20
30 hr	10	10	40	10
36 hr	20	0	30	0
42 hr	20	20	30	0
48 hr	20	7.5	30	10

VAS – Visual analogue scale, ESP – Erector spine plane, GA – General anesthesia, IQR – Interquartile range

Table 4a: Postoperative nausea and vomiting

Time-point	Group: ESP (*n*=57)	Group: GA (*n*=63)	*P*
PACU	57/0/0/0	37/5/6/15	0.0024
1 hr post-op	55/2/0/0	34/14/11/4	0.0019
4 hr post-op	56/0/0/1	44/3/10/6	0.0049
8 hr post-op	57/0/0/0	53/4/3/3	0.0324
12 hr post-op	57/0/0/0	56/5/2/0	0.8172
24 hr post-op	57/0/0/0	59/4/0/0	1.0200

ESP – Erector spine plane, GA – General anesthesia, *n* – Number of patients, PACU – Post-anesthesia care unit

Table 4b: Initiation of enteral feeds

	Hours after surgery				
	4	8	12	>24	>36
Group: ESP (*n*=57)	47	10	0	0	0
Group: GA (*n*=63)	0	0	12	37	14

ESP – Erector spine plane, GA – General anesthesia, *n* – Number of patients

Table 4c: Length of hospitalization

	Day of discharge from the hospital									
	1	2	3	4	5	6	7	8	9	10
Group: ESP (*n*=57)	0	0	19	33	4	1	0	0	0	0
Group: GA (*n*=63)	0	0	0	0	0	7	14	23	16	3

ESP – Erector spine plane, GA – General anesthesia, *n* – Number of patients

This profound anesthesia and analgesia can be contributed due to the extensive craniocaudal spread of local anesthetic agent involving the intercostal spaces, epidural and neural foraminal[8]; and attaining a paravertebral coverage of cranial and caudal three to four vertebral levels. Thereby effectively blocking the ventral as well as dorsal branches of the spinal nerves[9,10] and the communicating branches of the sympathetic chain leading to sympathetic block[11] and an extensive somatic as well as visceral analgesia. ESP block when performed at T2 or T3 covers the C5 and C6 nerve roots also and hence the suprascapular nerve, axillary and lateral pectoral nerve are also blocked.[12] The latter being important concerning the development of PMPS if left spared. The extent of erector spinae muscle stretching from cervical to lumbar areas has been associated with multiple dermatomal anesthesia with a local anesthetic volume of 20-30 ml in adults.[13]

Breast surgery patients often have frequent episodes of PONV,[14] due to the surgery itself or opioid analgesics used in the perioperative period. In our study, due to the opioid-sparing profile of the ESP group minimal PONV was observed compared to the control group. We observed that ESP block has several other advantages over GA. Apart from having better pain control they tolerated enteral feeds earlier without any complications and were also discharged earlier from the hospital thereby curtailing the financial burden of the patient with a lesser probability of hospital-related infections, and the overall psychiatric influence of prolonged hospital stay.

The limitation of our study was that we did not focus upon the speed of dermatomal blockade achieved after injection of local anesthetic in erector spinae plane block. Also, we did not include the erector spinae plane block failure cases. A future prospective study can be aimed to evaluate the onset, speed and regression of each dermatomal block in erector spinae plane block.

CONCLUSION

We conclude that ESP block is a safe alternative to GA for breast oncological procedures and is associated with profound perioperative analgesia, early discharge of patients to home, a lower rate of complications i.e., nausea, vomiting, pain, etc., and the negligible probability of frozen shoulder and post-mastectomy pain syndrome.

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Conflicts of interest
There are no conflicts of interest.

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