

The Patient-Reported Outcome of Intra-Operative Direct Vision Pectoral Nerve Block for Postoperative Analgesia for Breast Surgery

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Abstract

Background and Aims: Pectoral nerve blocks gained increasing recognition for adequate postoperative pain relief following breast surgery. Traditionally, anaesthetist administered preoperatively under ultrasound guidance, which added significantly to the total procedure time. We studied the effectiveness of intraoperative direct vision pectoral nerve block and reduction of total theatre time. **Methods:** We provided questionnaires to the eligible patients who underwent a mastectomy and or axillary node clearance from August 2018 to May 2019. All the patients had an intra-operative pectoral 1 and serratus plane (Pecs) block. Participants documented pain score twice daily, episodes of nausea or vomiting and type and dose of analgesia for the first seven postoperative days. We compiled and grouped the results into postoperative days 1 - 2 and 3 - 7 for data analysis. **Results:** Patients reported generally low levels of pain, with a median pain score of 1.75 out of 10 for postoperative days 1 - 2 (IQR 4). The score decreased to 0.7 for days 3 - 7 postoperatively (IQR 3) suggesting that most patients had generally minimal levels of pain apart from a few outliers. The average injection time for PECs blocks was 5 minutes, significantly less than USS guided techniques of 20 - 30 minutes. **Conclusions:** Our data suggest that nerve blocks under direct vision offer satisfactory efficacy in postoperative analgesia with minimal nausea and vomiting. This is in addition to substantial benefits in operative efficiency and reduction of total procedure time.

[#]The authors contributed equally to this article.

Keywords

Breast Cancer, Analgesia, Pectoral Nerve Block

1. Introduction

Conventionally postoperative analgesia for breast surgery includes a multimodal approach with intra-operative infiltration of long-acting local anaesthetics like levobupivacaine, a combination of oral and intravenous paracetamol, nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids when necessary. While general anaesthesia is still very commonly used for breast surgery, there has been a surge for regional techniques like pectoral nerve block 1 and serratus plane block (PECs block), paravertebral blocks and thoracic epidural techniques for analgesia, as well as a primary modality in patients who are high risk for anaesthesia [1]. Ultrasound-guided PECs block was described by Blanco *et al.* and has been very popular among anaesthetists [2] [3]. Although ultrasound-guided PEC1 and PEC2 blocks considered safe and provide significant intra and postoperative analgesia, there has been a case report of accidental infiltration to the brachial plexus resulting in short term numbness of the ipsilateral hand [4]. Single-shot PEC1 and PEC2 block and with or without further top-up in the postoperative period with the retained epidural catheters in both fascial planes also have been evaluated with randomised clinical trials [5] [6] [7]. Some of the studies have also revealed that pectoral and serratus plane block can reduce intraoperative fentanyl requirement, postoperative pain, postoperative morphine consumption, and postoperative nausea and vomiting (PONV) among those patients undergoing breast cancer surgery [8]. The Pecs block has been observed with fewer complexities and few complications when compared with thoracic paravertebral and thoracic epidural blocks in terms of analgesia quality [9] [10]. PEC II block has been efficient in providing pain relief among patients undergoing radical mastectomy. The present study has also presented the effectiveness of intraoperative direct vision pectoral nerve block and total theatre time reduction [11].

Ultrasound-guided PECs block was common practice in our hospital for the patients undergoing simple mastectomy with or without immediate reconstruction and for patients having axillary node clearance with wide local excision or mastectomy. When we audited our data regarding total theatre time, we had noticed that ultrasound-guided blocks required 20 - 30 minutes extra time. While direct vision intraoperative PECs blocks have been described by Goswami *et al.* and authors left the epidural catheter in the myofascial planes for postoperative analgesia, Haydon *et al.* described the techniques of direct vision serratus plane block (PEC2) for breast reconstruction using subpectoral implants [12] [13]. Several publications, including metaanalysis, showed PECs blocks were associated with less postoperative opioid use leading to shortened recovery time [7] [14]. We endeavoured to inject long-acting local anaesthetics (levobupivacaine) in the

myofascial plane (PEC1 and serratus plane) before wound closure under direct vision to decrease total time under general anaesthesia.

1.1. Breast Innervation

The sensory innervation of the breast is carried by the lateral and anterior cutaneous branches of the 2nd through the 6th intercostal nerves. The sensation of the breast is derived from the dermatomes of breast development and is found to be segmented. The lateral mammary branches are responsible for supplying the skin covering of the breasts. The sensory anterior intercostal nerves are responsible for innervating the medial parts of the breast skin, while supraclavicular nerves do not contribute towards sensory innervation of skin covering in the breast [15]. The lateral branches of the 2nd intercostal nerve are responsible for the origin of the intercostobrachial nerve through the axilla to join the cutaneous nerve of the arm. The innervation of the nipple-areola complex and the central breast is derived from the anterior and lateral cutaneous branches of the 3rd, 4th, and 5th intercostal nerves [16].

1.2. Aims and Objectives

To study the effectiveness of intraoperative direct vision pectoral nerve block to provide adequate postoperative analgesia and reduction of total theatre time.

2. Method

We conducted this prospective observational study following approval from the clinical governance department. The anaesthetic team was informed and agreed with the intraoperative surgeon-led blocks.

We obtained informed consent from all the patients before surgery. The anaesthetic team was informed and agreed with the intra-operative surgeon led blocks. Patients undergoing breast cancer surgery were eligible for the study. Age of entry was 18 or over. Mental capacity was assessed in the consent clinic prior to surgery. Information regarding the study were provided in the consent clinic and participation was voluntary.

All the patients undergoing simple mastectomy with or without axillary node clearance and all the patients who underwent axillary node clearance with or without simultaneous breast surgery from August 2018 to May 2019 were included.

Patients with arthritis, chronic back pain, fibromyalgia, or other chronic conditions, who were on regular non-opioid, steroids or opioid analgesics were excluded from the study. There was no age restriction in this study.

We explained the procedure to eligible patients at the consent clinic, and participation was voluntary. We distributed an anonymous questionnaire regarding postoperative pain in the visual analogue scale (VAS) to all the participants pre-operative with adequate explanation. Patients who had bilateral procedures

were given two separate questionnaires to complete. Participants were asked to record VAS pain score twice daily, type and quantity of analgesia and any episode of postoperative nausea or vomiting (PONV). Out of 43 questionnaires we distributed, 36 were completed and returned. We compiled and analysed the data after grouping them as postoperative days 1 - 2 as group 1 and postoperative day 3 - 7 as group 2.

2.1. Techniques of PEC1 and PEC2 Block

At the beginning of surgery patient's ipsilateral arm was abducted at an angle of 90 degrees on the operating table with the help of a multi-axis surgical arm board which is very standard practice for every breast surgery in our unit. For patients with restricted shoulder mobility, the angle was decreased to 70 - 80 or less depending on individual circumstances. We performed PEC1 and 2 blocks after completion of mastectomy or axillary node clearance before the closure of the wound. Although injected under direct vision, we followed the principles of ultrasound guided PEC1 and 2 blocks described by Blanco *et al.* We injected 20 ml of 0.25% levobupivacaine in the myofascial plane between the pectoralis major and minor muscle with a depth of about 1 - 3 cm to block medial and lateral pectoral nerves (PEC1 block). We then injected another 20 ml of 0.25% levobupivacaine in the interfascial plane between the pectoralis major muscle and the serratus anterior muscle in a depth of 3 - 6 cm aiming to block intercostal nerves 3 to 6, the long thoracic and intercostobrachial nerves (PEC2 block). Fascia covering the serratus anterior was injected on the midaxillary line at the level of the 5th intercostal space. Injection carried out in 4 increments of 5 ml each for both blocks. We took extreme care to avoid accidental injection to blood vessels or in the pleural cavity. The total procedure time was 5 minutes. We did not experience any procedure-related immediate or delayed complication.

2.2. Statistical Method

Descriptive statistics have been used for analysing the questionnaire after grouping them as postoperative days 1 - 2 as group 1 and postoperative days 3 - 7 as group 2. The mean and standard deviation has been used in descriptive statistics for analysing the result. The median and interquartile range was calculated for pain score.

3. Results

It was observed that out of 43 participants, 36 returned the completed questionnaire. The mean age was 65 years, and the median was 70 with a range of 33 - 84 years (**Table 1**). Analysis of the type of surgery revealed that six patients had only axillary node clearance. Out of 25 patient who had a mastectomy, only two had bilateral mastectomies. Five patients had wide local excision with axillary node clearance (**Table 2(a)** and **Table 2(b)**).

Table 1. Age of participants.

	N	Minimum	Maximum	Mean	Std. Deviation
Age at time of operation	36	33.00	85.00	65.1944	15.33590
Valid N (listwise)	36				

Table 1: A total of 36 participants who had undergone surgery constituted study sample in this study. The mean age of the respondents was 65.19 years ranging from 33 to 85 years. The median age was 70 years.

Table 2. (a) Types of Operation; (b) Patients Demographics and analgesics requirement.

(a)					
Operations	Frequency	Percent	Valid Percent	Cumulative Percent	
Axillary node clearance	1	2.8	2.8	2.8	
Bilateral mastectomy + SLNB	1	2.8	2.8	5.6	
L therapeutic mastectomy and R risk-reducing mastectomy	1	2.8	2.8	8.3	
Left ANC	2	5.6	5.6	13.9	
Left Mastectomy + ANC	1	2.8	2.8	16.7	
Left mastectomy	2	5.6	5.6	22.2	
Left Mastectomy + ANC	1	2.8	2.8	25.0	
Left mastectomy + SLNB	2	5.6	5.6	30.6	
Left Mastectomy + SLNB	1	2.8	2.8	33.3	
Left mastectomy + SNLB	1	2.8	2.8	36.1	
Left Mastectomy and AN sampling	1	2.8	2.8	38.9	
Left mastectomy and reconstruction	1	2.8	2.8	41.7	
Left mastectomy and SLNB	1	2.8	2.8	44.4	
Left prophylactic Mastectomy	1	2.8	2.8	47.2	
Left total Mastectomy	1	2.8	2.8	50.0	
Left WLE + ANC	2	5.6	5.6	55.6	
Right ANC	3	8.3	8.3	63.9	
Right ANC + Inferior Cavity shave	1	2.8	2.8	66.7	
Right breast WLE + ANC	1	2.8	2.8	69.4	
Right completion mastectomy	1	2.8	2.8	72.2	
Right mastectomy	1	2.8	2.8	75.0	
Right mastectomy + ANC	2	5.6	5.6	80.6	
Right Mastectomy + ANC	3	8.3	8.3	88.9	
Right mastectomy + SLNB	2	5.6	5.6	94.4	
Right WLE + ANC	2	5.6	5.6	100.0	
Total	36	100.0	100.0		

(b)

Age	Type of Surgery	Form returned	Days of analgesia	Type of analgesia	Episodes of nausea and vomiting	Nonopioid analgsocs (day 1 - 2)	Nonopioid analgesics (day 3 - 7)	Opioid analgsocs (day 1 - 2)	Opioid analgsocs (day 3 - 7)
69	Left Mastectomy and AN sampling	Yes	0	nil	0	0	0	0	0
55	Right Mastectomy + ANC	Yes	7	opioid	0	Ibuprofen 400 mg, Pcm 500 mg	Paracetamol 3 g	Codeine 30 mg	Codeine 180 mg
73	Right Mastectomy + ANC	Yes	7	non-opioid	0	Paracetamol 4 g	Paracetamol 7 g	0	0
82	Right mastectomy + SLNB	Yes	3	non-opioid	0	0	0	0	0
79	Left mastectomy and SLNB	Yes	3	opioid	0	Paracetamol 1.5 g	Paracetamol 1 g	Codeine 60 mg	0
78	Left total Mastectomy	Yes	2	non-opioid	0	Paracetamol 2 g	0	0	0
47	Left prophylactic Mastectomy	Yes	7	non-opioid	0	Paracetamol 4 g, Ibuprofen 1.6 g	Paracetamol 5 g	0	0
70	Left Mastectomy + ANC	Yes	3	non-opioid	0	Paracetamol 2.5 g	Paracetamol 1 g	0	0
61	Right ANC	Yes	0	nil	0	0	0	0	0
77	Left mastectomy	Yes	0	nil	0	0	0	0	0
48	Right WLE + ANC	Yes		non-opioid	0	Paracetamol 4 g	Paracetamol 10 g	0	0
82	Axillary node clearance	Yes	3	non-opioid		Paracetamol 3.5 g	Paracetamol 500 mg	0	0
84	Left Mastectomy + SLNB	Yes	1	non-opioid	0	0	0	0	0
61	L therapeutic mastectomy and R prophylactic mastectomy	Yes	4	non-opioid	0	Paracetamol 1.5 g	Paracetamol 1 g	0	0
81	Bilateral mastectomy + SLNB	Yes	1	non-opioid	0	Paracetamol 2 g	0	0	0
79	Left ANC	Yes	1	non-opioid	0	Paracetamol 1 g	0	0	0
78	Left ANC	Yes	4	opioid	0	Paracetamol 1 g	Paracetamol 1 g	Codeine 60 mg	Codeine 60 mg
41	Left mastectomy + SLNB	Yes	7	non-opioid	0	Paracetamol 4 g, Ibuprofen 1.2 g	Paracetamol 5 g, Ibuprofen 1.2 g	0	0
72	Right ANC	Yes	0	nil	0	0	0	0	0
65	Right ANC + Inferior Cavity shave	Yes	7	non-opioid	1	Paracetamol 4 g	Paracetamol 10 g	0	0
40	Left WLE + ANC	Yes	3	non-opioid	0	Paracetamol 4 g	0	0	0
44	Left mastectomy	Yes	5	opioid	0	Paracetamol 500 mg	Paracetamol 2 g	Codeine 30 mg, Oramorph 10 mg	0
34	Right WLE + ANC	Yes	2	non-opioid	0	Paracetamol 2 g	0	0	0

Continued

83	Right mastectomy + ANC	Yes	0	nil	0	0	0	0	0
78	Right ANC	Yes		nil		0	0	0	0
74	Left mastectomy + SLNB	Yes	0	nil	0	0	0	0	0
51	Left mastectomy and reconstruction	Yes	4	nil	0	Paracetamol 2 g	Paracetamol 2 g	Tramadol 200 mg, Oramorph 10 mg	Tramadol 200 mg
72	Right completion mastectomy	Yes	0	nil	0	0	0	0	0
33	Left WLE + ANC	Yes	0	nil	0	0	0	0	0
70	Right breast WLE + ANC	Yes	2	non-opioid	0	Paracetamol 2 g	0	0	0
70	Right mastectomy + SLNB	Yes	7	opioid	1	Paracetamol 6 g	10g	Codene 360 mg	Codeine 600 mg
61	Right mastectomy	Yes		non-opioid	0	Paracetamol 4 g	Paracetamol 10 g	0	0
57	Right Mastectomy + ANC	Yes	5	non-opioid	1	Paracetamol 1 g	Paracetamol 4 g	0	0
85	Left mastectomy + SNLBx	Yes	0	non-opioid	1	0	0	0	0
65	Right mastectomy + ANC	Yes	4	non-opioid	1	Paracetamol 2.5 g	Paracetamol 3 g	0	0
48	Left Mastectomy + ANC	Yes	7	non-opioid	0	5 g	0	0	0

On 1 - 2 postoperative day, the maximum percentage of the percentage of non-opioid analgesic used was 23.01% ranging from 0% to 75%. On 3-7th postoperative day, the percentage of non-opioid analgesic used was 11.04% ranging from 0% to 50%. Mean opioid analgesic use on 1 - 2 postoperative day was 4.09% ranging from 0% to 75%, and 2.06% on postoperative 3 - 7 ranging from 0 to 50% (**Table 3**). Mean VAS scores on 1 - 2 postoperative day were 2.08 and 1.58 on postoperative day 3 - 7.

The most common non-opioid analgesic was paracetamol 1 gm up to four times a day. Only 23% of patients used 4 g of paracetamol per 24 hours within the first two postoperative days, and 77% of the patients had 3 g or less. On analysing data of day 3 - 7 post-op days, only 11% were found to used 4 gm of paracetamol per days, leaving 89% of patients' pain was controlled with less than optimum doses.

The most common opioid analgesic was codeine phosphate tablets used by five patients (14%) in group 1 and 3 patients (8%) in group 2. The second most opioid analgesic was oral morphine solution 10 mg/10ml (Oramorph). Only two patients used as required oramorph along with paracetamol within the first two days of operation. There was no recorded use of oramorph in the 3 - 7 days post-op group (**Table 4**).

Following PEC1 and two blocks, patients experienced minimal pain which has been reflected in the mean pain score of 2.08 in the visual analogue scale (1 - 10, where 1 was minimal pain or discomfort and 10 was very severe pain) in the postoperative day 1 - 2. The mean pain score for postoperative day 3 - 7 was 1.58. Median pain score for postoperative day 1 - 2 was 1.75 and 0.7 for 3 - 7 days (Table 5 and Figure 1). This indicated that apart from very few outliers, most patients had an incredibly low level of pain in the first week following surgery.

Table 3. Duration of analgesia requirement.

	N	Minimum	Maximum	Mean	Std. Deviation
Days of analgesia	36	00	7.00	2.9118	2.63275

Table 4. Type of analgesia.

	Frequency	Percent	Valid Percent	Cumulative Percent
nil	10	27.8	27.8	27.8
non-opioid	21	58.3	58.3	86.1
opioid	5	13.9	13.9	100.0
Total	36	100.0	100.0	

Table 5. Pain score.

Post Operative days	Median Pain Score	Inter-quartile range
Day1	2	4
Day2	1	3
Day3	0.5	3
Day4	1	3
Day5	0	3
Day6	0	3
Day7	0	3

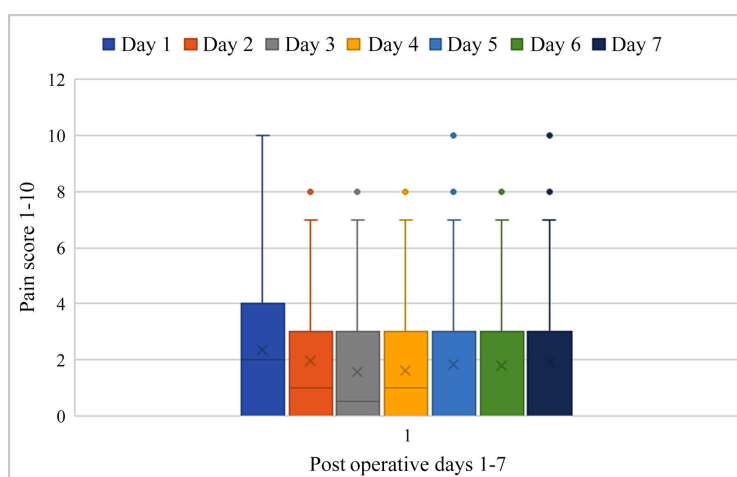


Figure 1. Box and whisker plot of pain score.

Reported rates of nausea and vomiting were low, with a mean of only 0.15 episodes for all seven days, with most patients reporting no episodes.

As PECs block routinely administered in our hospital by the anaesthetists, 20 - 30 minutes timeslots allocated in the operating list for this procedure. When we performed the block intra-operatively, the average time was 5 minutes per patient, only saving valuable operating time significantly.

There were no incidences of postoperative haemorrhage or pneumothorax in our series.

4. Discussion

Pectoral nerve blocks have become an essential tool in reducing postoperative pain in breast surgery. Blanco described pecs block under ultrasound guidance in a group of 50 patients, who only required non-opioid analgesia postoperatively with rare exceptions [17].

Goswami *et al.* randomised patients to receive either PEC1 versus PEC2 block for postoperative pain relief while performing modified radical mastectomy and found PEC2 block provided better postoperative analgesia than PEC1 block [6].

Verskyck *et al.* recently performed a meta-analysis of current literature that found the Pecs II block reduced postoperative pain scores as well as postoperative opioid use. They concluded nerve blocks offered superior analgesic efficacy versus systemic analgesia alone and comparable efficacy to thoracic paravertebral block for breast surgery [18].

Many nerve blocks discussed in the literature are performed under ultrasound guidance. Less data is available for nerve blocks performed under direct vision. Hards *et al.* conducted a retrospective study of 16 patients who received serratus plane blocks under direct vision and found none reporting severe pain in recovery or day one postoperatively. This compared favourably with a control group receiving local anaesthetic wound infiltration alone, where multiple patients reported severe pain over the same time [19].

Haydon *et al.* described lateral pectoral nerve blocks under direct vision for all of their subpectoral breast reconstruction and augmentation procedures [13]. They report that before introducing this nerve block, they routinely provided paracetamol, NSAID, and patient-controlled fentanyl postoperatively. Following the adoption of routine nerve blocks under direct vision, they found most patients declined opioid analgesia, managing satisfactorily with non-opioid alone.

We did not face any difficulty in the administration of direct PECs blocks. There were no immediate or delayed procedure-related complications which made this procedure safe and effective. We were able to save at least 20 - 25 of operating time by avoiding ultrasound-guided blocks. Although we did not use any indwelling catheter, our results were comparable to the study described by Goswami *et al.*, who used indwelling epidural catheter for further analgesia [6].

The main strength of our study was prospective data collection, communication with the patient before and after surgery and completion of data collection

within the first two weeks of operation when patients still remember the event. The small sample size is one of the limitations and the other one being no randomisation

5. Conclusion

Pectoral nerve blocks have been very popular recently to provide postoperative analgesia. Ultrasound-guided blocks remain a common practice but require skilled anaesthetists and equipment. While ultrasound-guided techniques are highly effective, we found similar efficacy of postoperative analgesia with direct vision technique with no significant increase in the operative time or complications. The risk of block failure was also very minimal. The learning curve for the open technique was also shallow compared to the steep learning curve of ultrasound-guided PECs blocks. As breast surgeons are remarkably familiar with the anatomy of the pectoral region and the procedures, do not add up extra operative time direct vision PECs block may be particularly suitable for breast surgery.

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CRedit Author Statement

Manas Kumar Dube: Methodology, original draft preparation, final writing, reviewing, and editing.

Jeffrey Wu: Conceptualisation, data collection, original abstract and draft preparation, writing, reviewing and editing.

Rishabha Deva Shrama: Statistics, reviewing and editing.

Yvonne Chang: Data collection, corrections.

Kishore Makam: Conceptualisation, Supervision.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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