

## ORIGINAL ARTICLE

# A pilot study to evaluate the efficacy of PEC blocks in minimising chronic post-mastectomy pain

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## ABSTRACT

This small prospective pilot study of 17 patients evaluated the efficacy of PECS block in preventing both immediate and long term post-operative pain after mastectomy. It describes the technique for performing a PECS blockade and demonstrated very low pain scores in both the peri-operative period and at 6 months.

**Key Words:** PEC block technique, Mastectomy, Post-operative pain

## 1. INTRODUCTION

Approximately one in eight women will be diagnosed with breast cancer during their lifetime, there were approximately 55,000 new cases of breast cancer diagnosed in the UK in 2014<sup>[1]</sup> and these numbers are predicted to keep rising each year. Surgical excision of the cancer remains at the core of treatment for most breast cancer patients and this is unlikely to change in the foreseeable future. Approximately 80% of newly diagnosed breast cancer patients have surgery and up to 40% of these will require a mastectomy.<sup>[2]</sup> Risk reducing mastectomies with or without reconstruction are also becoming increasingly common as are cosmetic breast procedures. The incidence of chronic pain after breast surgery is comparable, whether it's for cancer or cosmesis.<sup>[3,4]</sup> Currently a significant proportion of breast cancer survivors are living with debilitating pain. As breast cancer treatment becomes more successful, patients often live with these symptoms for decades. Chronic pain is defined as that which lasts or recurs for at least 3 months<sup>[5]</sup> and the World Health Organisation has

recognised it as a health condition in of itself in the new International Classification of Diseases.<sup>[6]</sup> It is a predominantly neuropathic pain that develops after surgical incision of the antero-lateral chest wall and/ or the ipsilateral axilla, which can injure numerous nerves in the surgical field and even lead to a 'phantom limb' pain.<sup>[7]</sup> A meta-analysis evaluating the association between chronic pain and mortality rates found an association between the two, although the result was not statistically significant, perhaps because of the heterogeneity of the included studies.<sup>[8]</sup> Reasonable sense would link the two however, as chronic pain leads to poorer Quality of Life (QoL) outcomes, which adversely affects health.<sup>[9]</sup> A study carried out on breast cancer survivors in Israel found a statistically significant link to the report of chronic pain symptoms and poorer QoL scores ( $p < .0001$ ) and showed that only 20% of women who worked full time prior to their diagnosis, carried on after their treatment and 52% of women downgraded to a part time job.<sup>[10]</sup> Neuropathic pain is notoriously difficult to treat and therefore, prevention is key.

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It is well established that treating acute pain successfully is the best preventative method.<sup>[11]</sup> The scientific basis for this theory has been well documented, with central nerve pathways continually transmitting pain signals, despite the original stimulus having been removed. This is called central sensitisation, which involves permanent modification of spinal neuronal pathways and signalling, that can lead to hyperaesthesia and chronic pain.<sup>[12-14]</sup> A meta-analysis published in recent years, shows 1.16 increased odds for developing persistent post-operative pain after breast cancer surgery, for every 1cm increase on the acute post-operative pain chart.<sup>[15]</sup>

This paper describes the technique for performing PEC blockade and the results of a pilot study that evaluated the efficacy of pre-operative local nerve blockade at preventing central sensitisation and the resulting effect on the incidence of reported chronic pain by post-mastectomy patients.

## 2. BLOCK TECHNIQUE

The block was carried out by a consultant anaesthetist prior to the surgical incision. With the patient anaesthetised in the supine position, a full aseptic technique was used to prepare suitable sterile areas. To facilitate full analgesic coverage of the operative field, a double block technique at two separate insertion points was undertaken. Low volume PECs I + PECS II plane blocks were used to cover the medial and lateral pectoral nerves, ensuring good analgesia of the superior anterior chest wall, in particular the sternal aspect and axilla. Additionally, a single shot high volume serratus anterior plane block was used to augment the consistency of analgesia to the axilla, lateral, inferior and to a degree, posterior aspects of the hemi thorax.

### 2.1 Technique employed for PECS I + II plane blocks

The mid-clavicular point was identified and the linear probe for a Sonosite high resolution ultrasound device was placed in a cephalic-pedal direction at right angles to the clavicle. The probe was moved inferior/laterally to the clavicle until the ribs of the anterior chest wall, anterior serratus, pectoralis minor and pectoralis major could be separately identified. The probe was aligned with the fibres of the pectoralis minor and a 100 mm 21G Pajunk nerve block needle was inserted in-plane with the beam, along a cephalic-pedal direction until the tip of the needle lay below the pectoralis minor muscle, superior to the serratus anterior muscle. At this point 0.2 mls/kg of 0.25% levobupivacaine was injected. The needle was then partially withdrawn until it lay in the plane between the pectoralis minor and pectoralis major muscles. Here a further 0.2 mls/kg of 0.25% levobupivacaine was injected.

### 2.2 Technique employed for Serratus anterior plane block

In the supine patient, the arm was abducted and supported at ninety degrees to the chest wall. A sonosite high resolution device was used to locate the approximate point on the lateral chest wall, where the mid-axillary line and 5th/6th intercostal space intersect. The linear ultrasound probe was then placed at that point, in a transverse plane, anterior to posterior orientation. The probe was moved posteriorly until the edge of the latissimus dorsi muscle was identified overlying the serratus anterior muscle. A 100 mm 21G Pajunk nerve block needle was inserted in-plane to the ultrasound beam in an anterior posterior direction, until the tip lay in the plane separating the body of Latissimus dorsi and serratus anterior. At that point 0.4 ml/kg of 0.25% levobupivacaine was injected.

## 3. METHOD

The Poole Hospital Foundation Trust Research and Innovation Committee gave ethical approval for the study. The PEC block technique was explained by the consultant anaesthetist and patients gave formal written consent to undergo the procedure.

A prospective cohort study was carried out looking at all patients operated on by the same surgeon over a 6 month period. Inclusion criteria were all patients who had a modified radical mastectomy +/- axillary procedure +/- reconstruction. There were no exclusion criteria based on age or pre-existing disease. Those patients who had breast conserving surgery or that did not receive a PECS +/- serratus block were excluded.

Data was collected at several time points including; in the anaesthetic room, the operating theatre, in recovery, on the wards and with a follow up phone call at 6 months. The universal pain assessment tool was used to grade the severity of the pain (0-10). The primary outcome of the study was to look at the incidence of pain at 6 months post-operatively. Secondary outcome measures were the effect of PECS blockade on peri-operative pain and the use of opiates.

The data gathered for each patient was as follows:

- Patient demographics
- Surgical Information
  - o Type of operation
  - o Type of reconstruction performed if any
- Anaesthetic information
  - o Type of block administered i.e. PECS1/PECS2/Serratus
  - o Type of local anaesthetic used, dose and concentration
  - o Use of intra-operative opioids
  - o Use of opioids in the immediate post-operative period
  - o Use of other analgesia intra-operatively
  - o Use of other analgesia post-operatively

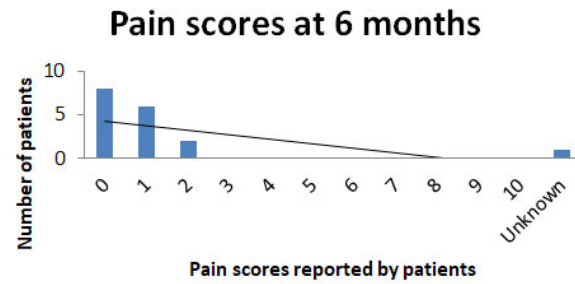
- o Use of post-operative anti-emetics
- Patient reported pain scores
- o In recovery
- o 24 hours post-surgery
- o At 6 months

#### 4. RESULTS

There were 17 patients in total who had a mastectomy during the 6-month time period for data collection. The breakdown of the type of operations carried out is detailed in Table 1. The mean average age of these patients was 68.3 years. The average post-operative length of stay in hospital was 24 hours.

**Table 1.** Operation type

Type of Operation	Number of Patients
Mastectomy	5
Mastectomy + sentinel lymph node biopsy	9
Mastectomy + axillary node clearance	1
Mastectomy and tissue expander insertion	1
Bilateral skin sparing mastectomy + sentinel node+ ADM +implant	1
<b>Total</b>	<b>17</b>



**Figure 3.** Patient reported pain scores at 6 months

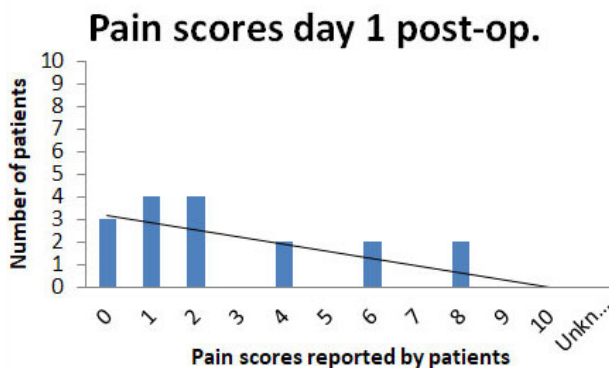
The type of block carried out, the local anaesthetic agent used and the dose varied between cases. All patients received a PECS block (either PECS1 or PECS2) and sometimes an additional anterior serratus plane block. The local anaesthetic used was either chirocaine or bupivacaine, with the dosage worked out according to the patient’s weight.

Figure 1 shows that most patients reported pain scores of 2 or less in recovery. Their analgesia requirements reflect this, with only one patient requiring rescue analgesia of 10 mg IV morphine but the rest receiving 1g IV paracetamol. This was the same at the 24-hour period post-operatively as shown in Figure 2, with only one patient requiring 10mg oramorph and the rest taking 1g paracetamol.

Figure 3 shows that at 6 months, no patients are reporting pain levels above 2, which on the universal pain assessment tool is described as ‘mild/ can be ignored.’ None of the patients at 6 months were taking analgesia specifically for post mastectomy pain. Two patients were taking ‘background analgesia’ for other ailments such as 300 mg gabapentin for arthritis. The data set was almost complete, with 3 unrecorded pain scores for patients in recovery and 1 patient lost to follow up at six months.



**Figure 1.** Patient reported pain scores in recovery



**Figure 2.** Patient reported pain scores 24 hours post surgery

#### 5. DISCUSSION

Previous studies have shown that regional blockade is an effective way of providing analgesia peri-operatively for mastectomy patients. A small cohort study compared 16 patients who received a serratus plane block prior to mastectomy, versus 11 patients who had local anaesthetic infiltrated into the wound prior to closure. The local anaesthetic was prepared by the anaesthetists according to the patient’s body weight at a concentration of 0.375% levobupivacaine with adrenaline and 1 µg/kg of clonidine. The mixture was passed to the surgeon, who then used 50% of the total available volume to inject directly below serratus anterior pre-operatively and use the remaining mixture at the end of the operation to infiltrate directly into the wound. The comparative cohort of patients had the same volume of the same local anaesthetic

mixture infiltrated into the wound, without the serratus plane block. None of the patients who received the serratus plane block reported any pain post-operatively, either in recovery or on day 1 after surgery, whereas 5 patients in the wound infiltration group reported severe pain in the first 24 hours.<sup>[16]</sup>

In the literature, PECS blockade is reported to be efficacious enough to be used as the sole analgesia for a patient undergoing breast conserving surgery and furthermore, no further analgesia was required by the patient in the subsequent 24 hours.<sup>[17]</sup> A meta-analysis of 8 randomised control trials and 2 cohort studies (993 patients in total), has been published recently comparing the analgesic efficacy of PECS blockade to that provided by a general anaesthetic for a modified radical mastectomy.<sup>[18]</sup> This showed that patients who had a PECS block used a statistically significant lower dose of opiates intra-operatively, the relative risk of post-operative nausea and vomiting (PONV) was reduced for PECS block patients at RR 0.64 ( $p = .004$ ) and the pain scores at 0 and 6 hours post-operatively were significantly lower for the PECS block group.

There has been little published about the effect of PEC blocks on chronic pain. A cohort study was conducted on patients experiencing chronic pain after breast surgery using a PECS block with 20 ml 0.25% bupivacaine and measuring the difference in pain scores pre and post block.<sup>[19]</sup> The PECS block provided statistically significant pain relief ( $P = .008$ ) and 30 minutes after the study, patients reported reduced hypoesthesia areas to cold and warmth. The analgesic effects and the subsequent reduction in sleep interference were still present one week after administration of the block.

A Cochrane review of pooled data from two RCTs, that compared pain scores in breast cancer surgery patients 6 months post-operatively, after they either had only GA or also had a paravertebral block concluded that the paravertebral block group had a significantly lower pain score at 6 months (odds ratio (OR) of 0.37, 95% CI 0.14–0.94) ( $P = .04$ ).<sup>[20]</sup> Studies such as these have paved the way to now explore the possibility that PEC blocks can provide prophylaxis against persistent post-operative pain when administered pre-operatively.

A risk propensity-matched cohort study of 225 patients who underwent day case breast cancer surgery compared PECS blocks vs serratus blocks vs control<sup>[21]</sup> and found that PECS blocks and serratus blocks halved the average dose of opiates used after surgery (40 mg to 20 mg approximately). They also cut the incidence of PONV from 88.7% to 32/33%. These are dramatic differences and the authors obtained statistical significance for these results. Although neither of these studies concentrate on post-mastectomy patients specifically, they are certainly relevant to this study and give extra

credence to the results.

Studies have shown that certain population groups are at higher risk for developing chronic pain after surgery than the general population. A systematic review and meta-analysis of observational studies, looking at risk factors for developing chronic pain after breast cancer surgery, included 30 studies and 19,813 patients in total.<sup>[15]</sup> Some high quality evidence was produced out of the pooled data, which showed that younger patients had higher odds of developing chronic pain (absolute increased risk of 7% for every 10 years below aged 70). Radiotherapy was associated with an odds ratio (OR) 1.35 (95% CI 1.16–1.57). Amongst the modifiable risk factors was a 21% increased absolute risk ratio (OR 2.41, 95% CI 1.73–3.35) if patients had an axillary node clearance and the odds increased with the severity of acute post-operative pain. The presence of preoperative pain also increased the odds to 1.29 (95% CI 1.01–1.64) but this was noted to be only of moderate-quality evidence.

A seminal paper published in 1996, looked at long term post-operative pain in 282 women and found a higher incidence of pain in women who had reconstructive surgery (49% vs 31% mastectomy alone).<sup>[4]</sup> This incidence increased to 53% if they had implant-based reconstruction, however this was low quality data based on patient questionnaires sent in the post. A larger cohort study including 310 subjects, found no statistically significant difference in the reported incidence of chronic pain between patients who had a mastectomy with (39%) and without reconstruction (38%) ( $p0.41$ ).<sup>[3]</sup> The meta-analysis described before produced high quality evidence that the type of breast surgery was not associated with chronic pain, inferring that the extent of surgical disruption to the tissues does not factor in.<sup>[15]</sup>

Relating these risk factors to the study group allows the results to be interpreted with more meaning. The mean age of our study group was 68.3 years; therefore, our study group was marginally at increased risk of developing chronic pain from this perspective. The number of patients who received radiotherapy was not recorded in this study and is a factor that could be accounted for in a larger future study. Two patients regularly used gabapentin or fentanyl patches for arthritis and fibromyalgia prior to surgery, baseline pain scores were not recorded and again would be important data to collect in a repeated larger study. Of note though, the dosage and/or frequency of their background analgesia did not change post-operatively. Only one patient was at greater risk of persistent pain due to an axillary node clearance having been carried out.

Two patients had implant reconstructive surgery. The first of these had bilateral mastectomies and acellular dermal matrix

reconstructions. The patient reported very low pain scores of 2 in recovery and then 1 at the 6-month phase, requiring only 1 g IV paracetamol whilst in hospital. The second patient who had a mastectomy and a tissue expander implant, had an unrecorded pain score in recovery but they required 10mg of 'rescue' IV morphine. On day 1 post-operative, they reported a pain score of 6 but at 6 months they had no pain at all. One would expect the first patient to have had greater pain levels acutely having had bilateral surgery. This reflects that pain severity can be unpredictable and it does not necessarily correlate with the severity of 'tissue damage.' Reassuringly, both of these patients had minimal or no pain at the 6-month period and this could be attributed to effective management of the acute post-operative pain before central sensitisation could occur.

Overall not many surgical or patient risk factors for chronic pain have been identified for this cohort of patients. This leads on to the consideration of acute post-operative pain levels. The use of PECS blocks reduced the need for morphine and its derivatives in the post-operative phase. The most frequent pain score in recovery was 0 on the visual analogue scale. Only 1 patient (5.9%) required opiates. 13/17 (76.4%) patients did not use any analgesia at all in recovery. On the first day post-operative, patients experienced slightly higher levels of pain in comparison, with 11/17 patients (64.7%) reporting a score of 2 or less. The pain spiked in severity for two patients, with pain scores of 8 being recorded. This is a classical pattern of pain severity after 'injury', where pain gets worse for 48-72hrs before it gets better or the effects of the PECS block were wearing off. This observation about pain levels on the first post-operative day has clinical implications, as it could mean that for day-case patients, pain may not be adequately controlled at home. In this study, all the patients stayed overnight in hospital, which allowed accurate assessment of analgesic requirements prior to discharge.

As the PECS blocks were recorded to reduce the use of opiates, one can assume that the incidence of PONV would have been reduced but again, this is data that would be recommended to be collected in a future study. In this study 87.5% (14/16) of patients experienced either no pain or intermittent mild pain (score 1) at 6 months post-operatively and did not require the use of extra analgesia. If they did score their severity of pain as 2, it was described subjectively as paraesthesia or ache. None of the patients reported a life interfering or limiting pain. This is an improvement on statistics reported by the literature, with an incidence of chronic pain being 37.5% and a median value of 3.22 cm on a 10 cm visual analogue scale.<sup>[15]</sup>

There was very little missing data, so this is unlikely to affect

the results overall as 16/17 patients were contacted for the crucial primary data outcome at 6 months. The data gathered from patients at 6 months was via a telephone conversation and one could argue that the patient should have been able to 'visualise' the scale, rather than envisage it by having the scale read out loud. Patients may also have wanted to 'please' the surgeon and down-play symptoms for various reasons. For this reason, it would be preferential to send the patient an email or text message survey, which reduces the chance of bias being introduced into the data collection. However, the operating surgeon did not undertake the telephone conversation in order to negate this bias.

This study was designed to be a pilot project and therefore, the number of patients included was always going to be too small to generate any meaningful statistics. Some encouraging results have been obtained and support the scientific theory. The next step would be to organise a repeat blinded randomised control trial to compare the efficacy of a GA with GA+ PECS block.

A pre-operative pain score as compared to the post-operative pain scores would be a useful analysis. Stringent definitions of what chronic pain is classed as for the purposes of the study should be documented, as this can be difficult to judge sometimes.

To optimise the quality of the data, ideally all patients would receive the same regional block with the same local anaesthetic agent. Those administering the block should undertake a training day, with a check assessment to reduce inter-operator variability.

## 6. CONCLUSION

Although this is a small pilot study, it is the first of its kind looking at the efficacy of pre-operative PECS blocks on preventing chronic pain after mastectomy. It has shown us that regional PECS blockade is associated with mild or no pain after a mastectomy in the long-term and none of the patients reported pain that interferes with their quality of life. This is a vast improvement on previously reported incidence of post-operative chronic pain, in the region of 40%. If pectoral blockade can reduce long term pain, by extension patients' QoL should improve, which is becoming more important as survival outcomes in breast cancer improve. The biopsychosocial effects of not being in pain will allow these patients to lead more fulfilling lives and ultimately be "happier." As a secondary outcome, our study has shown that using PECS blocks can significantly reduce the use of peri-operative opiates and the complications associated with their use. This may have an impact on patient flow in hospital and reduce post-operative length of stay after mastectomy. In the

future, a multi-centred, single blinded randomised control trial would be required to provide statistical evidence and ultimately encourage a widespread change of practice.

## CONFLICTS OF INTEREST DISCLOSURE

This paper was presented as a poster presentation, with an abstract, at the Association of Breast Surgeons meeting in 2018.

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