Chronic Pain Following Cosmetic Breast Surgery: A Comprehensive Review

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ABSTRACT

Introduction: Cosmetic breast surgery is commonly performed in the United States; 520,000 procedures of the total 1.8 million cosmetic surgical procedures performed in 2018 were breast related. Postoperative chronic pain, defined as lasting 3 or more months, has been reported in a wide variety of breast surgical procedures including breast augmentation, reduction mammaplasty, mastectomy, and mastectomy with reconstruction. Patient characteristics associated with the development of postoperative chronic pain following cosmetic breast surgery include a younger age, larger BMI, smaller height, postoperative hyperesthesia, and elevated baseline depression, anxiety, and catastrophizing scores. The anatomical distribution of chronic pain following breast augmentation procedures is dependent upon incision site placement; pectoral and intercostal nerves have been implicated. The purpose of

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this review is to provide an update on the current literature addressing the pathophysiology, clinical presentation, and treatment of patients presenting with chronic postoperative pain following cosmetic breast surgery.

Methods: A comprehensive literature review was performed in MEDLINE, PubMed, and Cochrane databases from 1996 to 2019 using the terms "cosmetic surgery", "breast surgery", "postoperative pain", and "chronic pain".

Results: Cosmetic breast surgery can have a similar presentation as post-mastectomy pain syndrome and thus have overlapping diagnostic criteria. Seven domains are identified for a diagnosis of PBSPS: Pain after breast surgery, neuropathic in nature, at least a moderate intensity of pain, as defined as within the middle one-third of the selected pain scale, pain for at least 6 months, symptoms occurring for 12 or more hours a day for a minimum of 4 days each week, pain in at least one of the following sites: breast, chest wall, axilla, or arm on the affected side, pain exacerbated by movement. Patient risk factors and surgical risk factors may influence the development of chronic post-cosmetic surgery breast pain. Improved perioperative analgesia including preoperative regional nerve anesthesia and postoperative catheter infusion have been shown to improve chronic postoperative pain outcomes.

Conclusions: The present review provides a discussion of clinical presentation, pathophysiology, and treatment and preventative strategies for chronic breast pain following cosmetic surgery. This review provides evidence from multiple randomized controlled trials (RCTs) and systematic reviews of efficacy and effectiveness. While chronic postoperative breast pain remains challenging to treat, various preventative strategies have been described to improve postoperative pain outcomes.

Keywords: Breast augmentation; Breast surgery; Chronic pain; Cosmetic surgery; Mammaplasty; Mastectomy; Reduction

Key Summary Points

Postoperative chronic pain has been reported in a wide variety of breast surgical procedures including breast augmentation, reduction mammaplasty, mastectomy, and mastectomy with reconstruction.

Patient characteristics associated with the development of postoperative chronic pain following cosmetic breast surgery include a younger age, larger BMI, smaller height, postoperative hyperesthesia, and elevated baseline depression, anxiety, and catastrophizing scores.

The anatomical distribution of chronic pain following breast augmentation procedures is dependent upon incision site placement; pectoral and intercostal nerves have been implicated.

The purpose of this review is to provide an update on the current literature addressing the pathophysiology, clinical presentation, and treatment of patients presenting with chronic postoperative pain following cosmetic breast surgery.

INTRODUCTION

Cosmetic breast surgery is commonly performed in the United States. Based upon estimates per the American Society of Plastic Surgeons (ASPS), of the 1.8 million cosmetic surgical procedures performed in 2018, over 520,000 procedures have been breast related [1]. Breast augmentation is the overall leading cosmetic surgery with an estimated 313,735 procedures performed, a 4% increase since 2017 and 48% since 2000 [1]. The increasing number of cosmetic breast surgeries necessitates continued evaluation of postoperative outcomes and complications. Postoperative chronic pain, defined as lasting 3 or more months, has been

reported in a wide variety of breast surgical procedures including breast augmentation, reduction mammaplasty, mastectomy, and mastectomy with reconstruction. Historically, incidence of chronic pain has been reported to be correlated with increasing invasiveness of surgical procedure: 49% for mastectomy with reconstruction, 31% for mastectomy, and 22% for breast reduction [2]. Even with advanced pain management strategies and surgical techniques, recent studies have continued to report an elevated incidence ranging from 20 to 43%; however, further analysis has found no evidence supporting a difference in chronic pain incidence based upon the type of surgical procedure [2–8]. While the financial impact of postoperative chronic breast-related pain has not been directly elucidated, chronic pain burdens the system via direct costs of healthcare resources and indirect costs related to reduced workplace productivity [9].

Patient characteristics associated with the development of postoperative chronic pain following cosmetic breast surgery include a younger age, larger BMI, smaller height, postoperative hyperesthesia, and elevated baseline depression, anxiety, and catastrophizing scores [3–5, 10–12]. Each of these characteristics must be individually considered when evaluating for risk of chronic pain. In particular, elevated rates of baseline anxiety and depression in breast cancer patients may predispose this patient population to have chronic pain following mastectomy and breast reconstruction [13, 14]. Interestingly, baseline chronic pain was found not to be correlated with increased rates of postoperative chronic breast-related pain [3]. Additionally, compared to their pain-free counterparts, patients living with chronic pain have reported lower QoL in terms of daily activities, physical and social functionality, and their mental health [4, 9]. Overall, patients with chronic pain have lower levels of cosmetic satisfaction [4, 5, 11].

This review, therefore, will provide an update on the current literature addressing the pathophysiology, clinical presentation, and treatment of patients presenting with chronic postoperative pain following cosmetic breast surgery. Moreover, this review can offer insight and awareness into the clinical implications associated with this syndrome and offers a comprehensive overview of rapidly developing treatment strategies. This article is based on previously conducted studies and does not contain any studies with human participants or animals performed by any of the authors.

PATHOPHYSIOLOGY

Nerve fiber damage during cosmetic breast surgery has been evaluated for commonly implicated nerves. The intercostal nerves were the most commonly implicated nerve, with a 74% incidence [15]. The regions affected by nerve damage correlate to the type of procedure performed and where incisions occurred. The location of chronic pain following breast augmentation procedures was dependent upon the incision site [15]. The following procedures and nerves damaged were: periareolar augmentations (third and fourth intercostals in the central zone), inframammary incisions (fifth and sixth intercostals in the inferior zone), transaxillary augmentation (second intercostal in the lateral zone), transumbilical method (tenth intercostal in inferior zone), breast reduction (third–fifth intercostal nerves in the central, inferior, and lateral zones), breast reconstruction (third–seventh intercostal nerves in the lateral, inferior and medial zones), mastopexy (third and fourth intercostal nerves in the central zone), and radiation (third–seventh in all zones) [15]. Additionally, mastectomies with axillary dissection resulted in second–sixth intercostal nerve damage in the lateral, inferior, and medial zones [15].

Initially following damage, acute pain is mediated by an increased firing rate of nociceptive neurons ($A\delta$ and C fibers) enhanced by local inflammatory mediators (i.e., prostaglandins, cytokines, and bradykinins). These mediators sensitize the local peripheral environment to pain, resulting in a *primary hyperalgesia*. Following tissue insult with prolonged or intense pain, the central nervous system may become sensitized, termed *secondary hyperalgesia* [16–18]. This neuropathic pain drives the transition from acute to chronic pain and is

characterized by pain to non-noxious stimuli (allodynia), pain out of proportion to noxious stimuli (hyperalgesia), and pain in the absence of stimuli (spontaneous pain) [16, 17]. Current understanding suggests the continuous and prolonged discharge of nociceptive neurons, reduced activation threshold, and spontaneous activity of dorsal horn neurons each contribute to the phenomenon of central sensitization.

Persistent peripheral stimulation results in the release of inflammatory mediators such as bradykinin, prostaglandin, 5-hydroxytryptamine (5-HT/serotonin), brain-derived growth factor (BDGF), interleukin-1 β (IL-1β) and -6 (IL-6), nerve growth factor (NGF), and tumor necrosis factor-α (TNF-α) stimulating peripheral neuroplasticity [16, 17]. These inflammatory mediators result in either the stimulation or the enhanced sensitization of the primary afferent fiber [16]. Histamine activation then drives further release of substance P and calcitonin gene-related peptide (CGRP) to enhance inflammation [16, 17]. Inflammatory marker-induced upregulation of sodium channels and phosphorylation of intracellular cascades within the nociceptive neuron reduce the threshold for an action potential, increasing the likelihood of chronic pain [17].

At the synapse between the primary and secondary afferent neurons in the dorsal horn of the spinal cord, repetitive depolarization of the nociceptive fibers stimulates selective gene expression via the activation of post-synaptic α-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid (AMPA), N-methyl-D-aspartate (NMDA), and neurokinine-1 receptors by glutamate and substance P, respectively [17]. Select gene expression, in the case of chronic pain, results in an enhanced excitability of nociceptive neurons. Regulation is achieved via Aβ fibers (activated by non-noxious stimuli) activation of GABAergic and glycinergic interneurons, inhibiting C fiber stimulation of secondary afferent neurons [17]. Sustained depolarization at the synapse results in elevated glutamate and displacement of magnesium from the NMDA receptor, which does not typically respond to nociceptive neurons [17, 18]. The addition of NMDA calcium influx overcomes the inhibitory effect of the interneurons

and allows a pain response to non-noxious stimuli.

These secondary afferent fibers subsequently ascend within the spinothalamic and spinoreticular tract to the thalamus and synapse with third-order neurons, distributing the signal to the somatosensory cortex, brainstem, and medulla [17, 18]. Additional inhibition of afferent pathways includes the descending inhibitory effects of the periaqueductal gray matter, rostral ventromedial medulla, and reticular formation [17]. It is suggested that dysfunction of the descending inhibitory pathway results in an increased risk of chronic pain [17].

CLINICAL PRESENTATION AND DIAGNOSIS

The timeline of developing chronic pain varies with each patient, although most of these patients experience some degree of acute pain following cosmetic breast surgery. Many patients experiencing chronic pain following breast surgery report some symptoms of neuropathic pain. Commonly reported symptomology by patients include sensations of pins and needles, burning, and numbness [11]. In addition, patients may experience itching, tingling, or tenderness in surgical sites from nerve disruption or damage [11, 19, 20]. Dysesthesia, hypoesthesia, or hyperesthesia are also experienced by patients following breast surgery [19]. In a study by von Sperling, investigators found that three-quarters of the patients experienced some sensory changes, with hypoesthesia as the most common neuropathic symptom in these patients [11]. In a larger systematic review of nerve injuries in breast augmentation by Ducic et al., investigators found that 13.57–15.44% of breast augmentation patients experienced some sensory changes, and around 9% of those patients experienced hypoesthesia [19]. Pain and hyperesthesia were the next most common neuropathic symptoms reported [19]. Specifically, patients mainly localized pain to the inframammary fold and nipple-areola complex following cosmetic breast surgery in the study by von Sperling et al. [11].

Notably, patient symptoms also depend on the specific nerve injured during surgery. Some common nerves injured include intercostobrachial nn, intercostal nerves (T2–6), and long thoracic nerve [19]. Each of these nerves will produce a different constellation of symptoms, such as pain in the breast aggravated with arm movement in intercostobrachial injury, or winged scapula after a long thoracic nerve injury [19, 21].

The definition or criteria for chronic pain syndrome following breast surgery is ambiguous and not very well defined. In an effort to standardize and clarify post-breast surgery pain syndrome (PBSPS), Waltho and Rockwell published a systematic review in which specific symptoms and criteria were laid out for its diagnosis [22]. While the systematic review mainly analyzed papers defining post-mastectomy pain syndrome (PMPS), the authors argue that any breast surgery can lead to a similar pain syndrome as after mastectomy and thus the criteria can be generalized to breast augmentation as well [22]. In general, seven domains were identified for a diagnosis of PBSPS: Pain after breast surgery, neuropathic in nature, at least a moderate intensity of pain, as defined as within the middle one-third of the selected pain scale, pain for at least 6 months, symptoms occurring for 12 or more hours a day for a minimum of 4 days each week, pain in at least one of the following sites: breast, chest wall, axilla, or arm on the affected side, pain exacerbated by movement [22]. Using these criteria to diagnose patients with chronic pain following breast augmentation can help standardize both clinical practice and research studies.

PATIENT RISK FACTORS

There have been many studies that have evaluated patient risk factors in the development of chronic pain following breast surgery. While some have focused on patient characteristics for breast augmentation, most recent literature focuses on chronic pain following breast reconstruction or mastectomy. This section will include factors associated with augmentation as well as other breast surgeries, as there is an overlap between the surgical procedures and outcomes.

The development of chronic pain is suspected to be multifactorial, with patient demographics, psychosocial characteristics, and various surgical techniques playing a role in its development. Many studies have cited the inverse relationship between patients' age and development of chronic pain after breast surgery, with differing explanations to why this may be [3–5, 23]. One explanation posited by Couceiro et al. is that younger patients have higher nerve sensitivity and a lower threshold for pain due to increased anxiety levels [20, 21]. In addition to young age, Kokosis et al., in their review of post-breast surgery pain syndrome, cited the positive relationship between higher BMI, defined as greater than 26, and the development of chronic pain that has been found in previous studies [7, 21].

Other factors associated with the development of chronic pain include psychosocial characteristics. Spivey et al. found a significant positive association between baseline degree of preoperative anxiety, depression, and pain catastrophizing with patients' Pain Burden Index after 6 months [3]. This positive relationship between baseline depression and anxiety has also been correlated with pain after 1 week following breast surgery [23]. While both of these studies focused on breast cancer patients undergoing reconstruction surgery after mastectomy, there have been studies highlighting the higher incidence of depression and anxiety in breast augmentation patients as well. Recently, a population-based study investigating mental health and psychosocial characteristics in patients undergoing breast augmentation found that augmentation patients often had more history of depression, anxiety, and eating disorders compared to the general population [24]. Thus, these findings of preoperative anxiety and depression correlating to chronic pain may be applicable and important to consider for breast augmentation patients as well.

Associations between postoperative pain and subsequent development of chronic pain have been explored. In a study by Romundstad et al., investigators found a significant association

between postoperative pain at 6 days, 6 weeks, and hyperesthesia at 6 weeks with the subsequent development of chronic pain at 1 year [10]. Similarly, Roth et al., found that higher acute postoperative pain correlated significantly with more severe chronic pain at 2 years after breast reconstruction [7]. Thus, it is important to also evaluate acute pain as a positive predictor of chronic pain development. The thorough evaluation of patients' risk factors for development of chronic postsurgical pain can be done in conjunction with the anesthetic preoperative, assessment most notably any prior history of pertinent psychosocial characteristics.

SURGICAL FACTORS

There are several surgical variables that may be associated with more severe post-reconstruction pain. In a study of 152 adult female patients, postoperative pain control was compared between those undergoing prepectoral breast reconstruction versus dual-plane device-based breast reconstruction. It was found that patients who underwent prepectoral reconstruction required significantly fewer days of postoperative opioid medication (4 vs. 7, $p = 0.009$) and a significantly smaller percentage of opioid prescription refills (10 vs. 17, $p = 0.005$). Overall, it was found that patients undergoing prepectoral reconstruction used opioids of 33% fewer days than those who underwent dual-plane reconstruction, suggesting that this surgical approach may be associated with reduced chronic postoperative pain. However, this study was limited by the lack of data on nonopioid medication consumed by patients [25]. In another study of 2207 women undergoing breast reconstruction, patients with deep inferior epigastric perforator (DIEP) flaps or superficial inferior epigastric (SIEA) perforator flaps had less pain 1 week postoperatively compared to tissue expanders/implant reconstruction on the McGill Pain Questionnaire-Sensory scale ($p < 0.01$, $p = 0.02$). On the BREAST-Q scale, pedicle transverse rectus abdominis musculocutaneous flap, DIEP, and SIEA were all associated with significantly less pain than tissue expander/implant surgery [23]. This suggests that tissue expander-based reconstruction may be associated with significantly more pain that other forms of surgical reconstruction. This is consistent with another retrospective review where tissue expander-based implant reconstruction was associated with higher analgesic requirements than single-stage II based reconstruction. In this study of 378 women, those who underwent tissue expander-based reconstruction used substantially more non-opioid ($p = 0.04$), opioid ($p < 0.01$), and benzodiazepine and muscle relaxant ($p = 0.06$) medications than those in the single-stage II reconstruction. There was no difference in those who had immediate versus delayed reconstruction following mastectomy. It is hypothesized that the larger area of dissection and sustained expansion may play in a role in increased pain post-operatively in tissue-expander implant reconstruction. Increased fill size (> 250 cc) was also associated with higher morphine equivalence compared to smaller fill size (< 250 cc) on postoperative day two [26]. In a study of 216 patients undergoing various types of breast surgery, the pain burden index (PBI) was significantly higher 6 months post-operatively in those with any type of axillary nodal procedure ($p < 0.001$). Duration of surgery did not impact pain [3]. In a 2-year follow-up study of patients who underwent breast reconstruction surgery, bilateral reconstruction was associated with increased chronic post-surgical pain syndrome ($p = 0.037$). This study of 1996 women was assessed preoperative and 2 years post-operatively for pain. They demonstrated that pedicle transverse rectus abdominis musculocutaneous flaps (PTRAM), DIEP, and SIEA reconstruction patients reported more severe pain than TE/I patients 2 years post-operatively. Although prior studies indicated that TE/I reconstruction is associated with greater pain outcomes, this study suggests that breast reconstruction pain may evolve over time. However, one potential limitation of this study is that 93% of patients received immediate reconstruction [7]. Further research is needed to understand which surgical techniques are associated with long-term postoperative pain.

TREATMENT AND MANAGEMENT

Often, medical management provides an avenue to remain comfortable through utilization of over-the-counter analgesics, neuropathic agents, or physical therapy. For some, conservative management is insufficient; strategies may be employed to include regional anesthesia and nerve blocks. Regardless, important consideration of each patients' risks for chronic pain should be assessed and addressed for primary prevention.

Medical Management

Medical management of chronic pain following breast augmentation surgery includes medications that are generally used to treat most chronic post-surgery pain syndromes. While there is no consensus on the best medication for chronic post-surgical pain, medical management may be trialed for at least 3 months before advancing to more invasive treatment strategies [27, 28].

One of the most common medications for initial management of chronic pain is the nonsteroidal anti-inflammatory drug [27, 28]. NSAID class. Inhibition of COX 1 and 2, can reduce inflammation in surrounding tissues and provide some degree of pain relief [29]. These medications are also associated with increased risk of bleeding and should be used with caution in older patients or those prone to bleeding.

Many patients with chronic pain following cosmetic breast surgery experience neuropathic pain. In these patients, medications such as gabapentin or pregabalin may provide some relief [27]. In large systematic reviews of chronic post-surgical pain syndrome, there is conflicting evidence as to the actual efficacy of either of these drugs [30]. In a systematic review of prevention and management of chronic postsurgical pain, the authors found that while some studies have shown benefit of perioperative pregabalin in reduction of chronic pain development at 6 and 12 months, a more recent meta-analysis by Martinez et al. found no difference in the development of chronic post-

surgical pain when comparing treatment with pregabalin or a placebo [30–32]. While there is no agreement on the efficacy of neuropathic pain medications, they may have modest impact on chronic pain development and more comprehensive studies should be done to investigate their specific role for patients undergoing cosmetic breast surgery.

Depression and anxiety are also correlated positively with the development of chronic post-breast surgery pain syndrome, and consequently, tricyclic antidepressant medication may provide some improvement of pain via modulation of neuropathic symptoms and through improving patients' mood [19, 33]. In the literature review by Larrson et al., it was found that both venlafaxine and amitriptyline are reasonable medications for post-mastectomy pain syndrome [33]. A recent meta-analysis involving 23 studies investigated the adverse effects of antidepressants in chronic pain patients and found that except for nortriptyline, all studied antidepressants had an increased incidence of side effects [34]. Tricyclic antidepressants were associated with significant anticholinergic and antihistaminic adverse effects, such as dry mouth and dizziness, and venlafaxine was associated with vomiting and somnolence [34]. The benefits of these medications should be weighed with adverse effects for each patient and their comorbidities for effective pain modulation.

Opioids are effective and often used for acute perioperative pain management in breast surgery [27]. However, with the risk for opioid dependence, especially with chronic use, these medications should be limited in patients undergoing breast augmentation [35].

Nonpharmacologic treatment options for chronic postsurgical pain include physical therapy, scar and myofascial massage, and psychological therapy [27, 28, 30, 36]. While the duration of pain relief from physical therapy or scar massage may be temporary, there is some evidence that different massage techniques may provide persistent pain relief following breast surgery [36]. Psychological therapy, such as cognitive behavioral therapy and operant conditioning, have also been evaluated as potential treatment strategies for chronic postsurgical

pain patients [30]. Cognitive therapy has been found to be as effective as some surgical interventions in patients with back pain and should be evaluated further for pain control in patients after cosmetic breast surgery [30].

Minimally Invasive Interventions

Perioperative anesthesia may influence the incidence of postsurgical pain in breast surgery patients. In a prospective observational study of 122 mastectomy patients, patients who received truncal regional anesthesia (TRA) reported lower mean pain scores 2 h after surgery compared to those who did not receive any TRA. In addition, patients who received the TRA had significantly lower opioid use (24 vs. 30 mg, p = 0.015). TRA was performed in two varieties, paravertebral (PVB) or proximal intercostal (PICB) using 0.25–0.5% local anesthetic. Two weeks post-operatively, there was no difference in pain scores between the two groups [37]. A meta-analysis of 604 patients concluded that multilevel PVB may be protective against chronic postsurgical pain up to 6 months post-operatively, suggesting there may be a long-term benefit [38]. Pectoral nerve block with liposomal bupivacaine has also been suggested to improve postoperative pain following elective breast surgery. In a case report of a 28-year-old female, bilateral pectoral nerve blocks with liposomal bupivacaine resulted in adequate pain control up to 10 days post-operatively [39]. Pectoral nerve blocks may be superior to thoracic paravertebral blocks (TPVB). In a randomized controlled trial of 40 female patients undergoing radial mastectomies, those that received pectoral blocks had lower morphine consumption compared to TPVB (3.9 vs. 5.4, p < 0.0001). Ropivacaine 0.5% of 10 ml was injected into the plane between the pectoralis major and minor. An additional 15 ml was then injected between the pectoralis minor and serratus anterior. The duration of analgesia was longer in the patients with the pectoral block (294 vs. 197 min) [40]. Similar results were found in a randomized controlled trial of 60 patients after breast reconstruction surgery. Those that received the pectoral II block in

which anesthetic is injected between pectoral major and minor as well as pectoral minor and serratus anterior reported more favorable outcomes than those who did not. Intraoperatively, there was a reduction in fentanyl consumption in the pectoral block group (p < 0.001) and morphine consumption 24 h post-operatively (p < 0.001) [41]. In a retrospective review of 22 patients who underwent salvage breast reconstruction with latissimus dorsi flaps, half received a single-injection TBVP versus continuous paravertebral block (cPVB). Those that received cPVB had lower pain scores than the tPVB group, although not statistically significant (p = 0.31). This suggests that a single tPVB is equally as efficacious in pain control as cPVB and patients may not need catheter directed pain control for breast reconstruction [42].

Only a few studies have evaluated postoperative pain management techniques in this population. In a study of 93 patients who underwent transverse rectus abdominus breast reconstruction, half were randomized to receive TAP catheters with bupivacaine vs. saline postoperatively. There were no significant differences between the two groups at 6 and 12 months postoperatively in terms of pain [43]. TAP blocks, however, were successful in reducing opioid consumption and pain scores in a study of 100 patients undergoing microsurgical breast reconstruction (p < 0.001). Furthermore, the group that did not receive a TAP block reported higher chronic pain diagnosis, however this was not controlled for potential confounding factors including BMI [44]. TAP blocks may be beneficial in patients with DIEP flap breast reconstruction. In a study of 30 women undergoing radical mastectomy followed by DIEP flap reconstruction, 15 patients received bilateral ultrasound-guided TAP blocks after the surgery. Morphine requirements were lower in the TAP block group up 48 h postoperatively (17 vs. 22, p = 0.0047) [45]. It is thought that optimal management of acute pain may decrease the development of chronic pain in these patients. Still, further research is needed to evaluate the long-term effects of TAP blocks on chronic postsurgical pain syndrome. A recent study evaluated the use of ultrasound-guided

intercostobrachial blocks (ICBN) in patients with persistent pain after breast surgery. Six patients received 10 ml of 0.5% bupivacaine under ultrasound-guided ICBN. Pain scores before and after the procedure were measured and the ICBN resulted in significant improvement in pain with a different of nine points ($p = 0.006$). Serratus plane blocks are another alternative treatment regimen for patients with postmastectomy chronic pain syndrome. In a case series of eight women with chronic pain, 10 ml of 0.25% bupivacaine and 40 mg of methylprednisolone was injected into a plane superficial to the serratus anterior muscle and below the latissimus dorsi muscle. The response to this block was variable, with patients experiencing 25% to complete pain relief post-procedure. In addition, the duration of pain relief was anywhere from 2 days to 3 months. A larger study is needed to evaluate the use of serratus plane blocks on postsurgical breast reconstruction pain [46].

Pulsed radiofrequency (PRF) stimulus may be a novel approach to pain management in patients with chronic post-surgical breast pain. In a case report of 52-year-old women with bilateral breast pain after breast reduction surgery that was refractory to both nerve blocks and local anesthetics, PRF was performed two times for 120 s at 42 °C bilaterally. The patient reported decreased VAS scores from 80–90 to 20–30 [47]. A similar result was found with the use of pulsed electromagnetic therapy. A randomized study of 32 patients undergoing TRAM flap breast reconstruction was randomized to receive active or sham pulsed electromagnetic field therapy. VAS pain scores and narcotic use were significantly higher in patients in the sham group ($p < 0.01$) 72 h post-operatively. The pulsed electromagnetic field therapy was delivered through disposable 18-cm-diameter coils that pulsed for 15 min every 2 h after surgery.

CONCLUSIONS

The occurrence of chronic pain following cosmetic breast surgery can be affected by patient risk factors, primary prevention strategies, and surgical technique. Patients with chronic post-operative breast pain present with continued pain 3 or more months following surgery and may have characteristics such as younger age, elevated BMI, and underlying depression or anxiety, putting them at an elevated risk. Differences have been observed in patient outcome based upon the surgical technique utilized. Additional research is needed to examine the effectiveness of primary prevention of modifiable risk factors in reducing the incidence of postoperative chronic pain. In addition, in-depth investigation into the most effective treatment regimens for those patients who develop chronic pain proves much to be desired with the focus aimed at the entire perioperative setting. While conservative management may be an effective treatment strategy for many patients, minimally invasive treatment options may off improved symptomatic relief. Further studies are needed to elucidate the pathophysiology associated with the occurrence of chronic postoperative breast pain in cosmetic surgery and moreover provide supportive evidence for treatment modalities.

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