Review Article

Factors Associated with Chronic Post-Thoracotomy Pain

Sara Eleni AMPRACHIM¹, Ioannis D. GKEGKES², Ioanna V. PAPATHANASIOU³, Labrini KOURKOUTA⁴*

Affiliation of the authors:
1. RN, MSc, Department of Thoracic Surgery, "KAT" General Hospital, Athens, Greece.
2. MD, Department of Thoracic Surgery, "KAT" General Hospital, Athens, Greece.
3. RN, MSc, PhD, Clinical Professor of Nursing, Nursing Department, Technological Educational Institute of Larissa, Greece
4. RN, PhD, Professor of Nursing, Nursing Department, Alexander Technological Educational Institute of Thessaloniki, Greece

Corresponding author:
Ioanna V. PAPATHANASIOU, RN, MSc, PhD
Clinical Professor
Nursing Department
Technological Educational Institute of Larissa, Greece
Phone: +302410684446
E-mail: papathan@teilar.gr, iopapathanasiou@yahoo.gr
Thoracotomy is one of the surgical procedures that present with increased incidence of chronic postoperative pain and discomfort. The related pain after thoracotomy can provoke considerable peri-operative as well as long-term morbidity of notable intensity and duration. Post-thoracotomy pain is considered to be a result of the thoracic structure damage, including damage to ribs, muscles, peripheral nerves and pleura. The surgical incision, the rib retraction, the discontinuity of costal pleura, trocar placement and suturing are the possible pathogenic causes of chronic post-thoracotomy pain. Various techniques and prevention strategies have been proposed in order to offer satisfactory analgesia to postoperative thoracotomy pain. Nevertheless, both acute and chronic pain related to thoracotomy continue to represent a challenge for thoracic surgeons. Recommendations can only be established in this regard based on unique studies, with a higher or lower level of evidence depending on their design. Well designed randomized prospective studies are required to evaluate the diverse technical variation for the performance of thoracotomy and their association with post-thoracotomy pain.

Keywords: Thoracotomy, Post-Thoracotomy Pain Syndrome (PTPS), Chronic Post-Thoracotomy Pain, Risk Factors, Prevention.

Introduction

Chronic pain after surgery (chronic post-surgical pain - CPSP) is one of the most common and serious complications after surgery. CPSP is associated with increased analgesic use, restriction of activities of daily living, significant effects on quality of life and increased health-care utilization [1].

CPSP is common but it is often not recognised or may be neglected or misdiagnosed. Chronic pain is costly to society in terms of suffering and disability. For humanitarian, medical and economic reasons, the problem of chronic pain after surgery should be addressed [2].

Pain after thoracotomy appears in a lot of patients [3, 4]. Thoracotomy is associated with the potential for severe pain, further impairment of lung function, delayed recovery and the occurrence of chronic pain [5].

Pain is one of the most important considerations in the care of thoracic surgical patients. Failure in pain management is associated with increased mortality and morbidity [6]. Unfortunately, many patients may have persistent pain lasting for many months, or even years, following thoracic surgery [7].

Definition and Incidence

The International Association for the Study of Pain (IASP) defines pain as “an unpleasant sensory and emotional experience associated with tissue damage” [8]. Chronic post-thoracotomy pain, or post-thoracotomy neuralgia, is defined by the same Association as a pain that recurs or persists along a thoracotomy scar for at least two months following the surgical procedure” [8, 9]. The prevalence of post-thoracotomy pain syndrome (PTPS) seems to be highly variable, but very frequent (about 50%). With the majority experiencing only mild pain, 3-16% experience moderate to severe pain [10]. Neuropathic features as sensations of
dysesthesia, allodynia or burning can be found in 35% to 83% of cases [11].

CPSP is reported in more than 50% of patients who have surgery associated with nerve and tissue damage, i.e., mastectomy, thoracotomy and amputation [1]. In a research study the frequency is reported in 5–65% for thoracotomy, 20–50% for mastectomy, 50–85% for amputation, 5–30% for hysterectomy, 30–55% for cardiac surgery and 5–35% for hernia repair [12].

Until recently, it has been a neglected topic, because it may appear after a wide spectrum of operations; however, little is known regarding its underlying mechanism, prevalence, risk factors and treatments [9]. Post-thoracotomy pain is a symptom of high incidence among patients who have undergone thoracotomy and is a major risk factor in the pathogenesis of several postoperative complications [13]. Chronic pain after thoracotomy reaches a high prevalence and it is a significant clinical problem in 25–60% of patients [10, 13]. Paradoxically, rib resection, which results in more intercostal nerve damage, is associated with a reduced incidence of post-thoracotomy neuralgia [1].

**Types of Thoracotomy**

In order to better understand the origin of PTPS is it necessary to examine closely the available surgical techniques. The most common types of thoracotomy are the posterolateral, the posterolateral muscle-sparing technique and the thoracoscopic method.

In the posterolateral, the patient is placed in the lateral position on the non-affected side with the arm of the affected side positioned anteriorly, away from the site of the surgical access. Through the major chest muscles (latissimus dorsi and serratus anterior), 4th/5th rib intercostal spaces and the parietal pleura, the surgeon gets access into the thoracic cavity. During this procedure, in order to get through the thoracic cavity, the ribs are frequently spread apart. Furthermore, the distension of the ribs may provoke fractures to the ribs themselves, damage to intercostal nerves as well as to the nerve bundles. Posterolateral access regularly has as consequence the muscle damage to the latissimus dorsi muscle as well as to the serratus anterior muscle [14].

The muscle-sparing thoracotomy gives access to the thoracic cavity by entering through the 5th/6th intercostal space with a small 6- to 10-inch moon shaped incision, where the major chest muscles can be spared and the muscle damage can be minimised [14, 15].

Last but not least, the thoracoscopic surgery refers either to video-assisted surgery (VATS) or robotic surgery. This procedure consists of three to five small (2-inches) incisions, through which thoracoscopic instrumentation is passed via the chest muscles, intercostal spaces of the ribs and the pleural cavity [16, 17]. Towards the end of every operation in the chest cavity, chest tubes should always be placed in the thoracic cavity, thus, causing additional trauma to the chest wall.

**Physiopathology of Post Thoracotomy Pain Syndrome (PTPS)**

In a thoracic surgical operation, independently of surgical technique, the causes of PTPS are focused on five points: 1. Surgical trauma and the intercostal nerve lesion due to compression. The nerve damage is often caused by the compression of intercostal nerves due to instruments and rib spreading during the operation [14, 15]. The most frequent presence is pain which is located along the intercostal nerve pathway, posteriorly from
the spine to the sternum. PTPS is often neuropathic and is usually described as a dull, itchy, prickly, tingling sensation.

2. Pain caused by rib fracture and rib spreading.

PTPS is generally presented as severe pain with radiation along the location of the rib trauma, fractured or spread rib site. Both thoracotomies and the thorascopic procedures present no significant difference in postsurgical analgesia needs during the first year of surgery [16].

3. Damage of the chest muscles and adjacent tissue structures.

Both surgical (surgical incision) and postsurgical (chest tubes and drainage) trauma may result in substantial damage to the thoracic wall structures. The inflammation and the injury of the chest wall muscles, the ribs and the nerves often cause severe and disabling pain [15, 18].

4. Atrophy of the thoracic muscles.

Atrophy or the damage of the thoracic muscles (latissimus dorsi and the inferior portion of the serratus anterior) can take place as a consequence of rib spreading [16, 17, 19].

5. Pain caused by pleura irritation.

Postoperative pain due to pleura irritation is often reported as pain with long duration, located mainly in the area of the wound or elsewhere in the chest. The pain referred is generally described as a soft pain. Carrying heavy objects, lying on the operated side, weather changes, working with the hand of the operated side, sitting and feeling depressed are the major factors that influence the presence of PTPS [14].

Pain Characteristics after Thoracic Surgery

A thoracotomy requires an incision that may prove very painful, involving multiple muscle layers, rib resection and continuous motion as the patient breathes [20, 21]. It has been shown that a large number of patients still suffer from thoracic pain 2–3 months after surgery, such cases having been reported up to seven years post-surgery [22]. Thoracotomy has been thought to be associated with a high incidence of chronic neurogenic pain, which might be reduced by good acute postoperative analgesia [20].

In order to gain access to the chest during chest surgery, inevitably mechanical trauma is caused both anteriorly and posteriorly. The intercostal nerves lie along the lower border of the ribs and are liable to injury, which may be quite subtle and need not involve transection. Experience from other pain syndromes suggests that many of the worst pain syndromes are caused by partial nerve injury. Therefore, it is not surprising to find that patients suffer a wide range of symptoms after thoracotomy [23].

Causes of Chronic Post Thoracotomy Pain Syndrome

Ideally, if such a complication is to be prevented, the causes and reasons for its occurrence need to be understood [24]. The main causes of chronic post-thoracotomy pain syndrome are: intercostal nerve injury – neuroma, tumour recurrence, myofascial pain syndrome, ‘frozen shoulder’, healing rib fractures, costochondritis, costochondral disruption, costovertebral disruption, infection, pleuritis and psychological distress [25].

Factors influencing the prevalence of PTPS

The causes of chronic pain after surgery are not fully known, but several risk factors have been identified, including the female gender, psychological and genetic factors, pre- and postoperative pain, and nerve injury during surgery [26].
It is likely that there are numerous factors affecting the incidence of persistent postoperative pain but we are only aware of some of them [12].

Female gender: The risk is increased in women [10, 27]. There is no clear evidence to suggest sex predominance but it was observed that women tended to report higher levels of pain with concomitant use of simple analgesics [25].

Age under 60 years: Chronic pain prevalence was significantly higher in younger patients [27-29]. It is well established in several types of surgery that the risk for chronification is decreased in elderly patients [10]. Younger patients reported more pain compared to the elderly [25]. The pain may be caused by damage to the intercostal nerves during surgery. However, some studies have suggested that young age at the time of surgery reduces the risk of developing chronic pain [26].

Genetic factors: In clinical practice we observe that there is significant inter-individual variability in the pattern in patient’s presentation, progression and response to therapy. It is extremely difficult to predict the response of an individual. There may be a role in the underlying genetic structure of the individual which might explain why some patients are more prone to post surgical pain. The attempt to identify such genes, which play a role in pain processing has shown some association with gene polymorphism of catechol-0-methyltransferase (COMT), genetic variants to determine voltage-gated sodium channels and GTP cyclohydrolase and tetrahydrobiopterin-related genes [25].

Diabetes mellitus: It is a risk factor for chronic post-surgical pain [28].

Psychological factors: It is well recognized that anxiety, depression, psychosocial factors, malignant disease and social status play a significant role in the genesis of chronic pain and the nature and severity of the disability associated with it [12, 27]. Fear and surgical stress might also be confounding factors [30].

Type and extent of surgery - intercostal nerve damage, resection of the chest wall, pleurectomy and pneumonectomy: Trauma and surgery have been well recognised as risk factors for developing chronic pain [25, 29]. Lesions to peripheral nerves are often associated with persistent postoperative pain [12]. Minimally invasive surgery using a thoracoscope has reduced nociceptive pain [7]. The introduction of video-assisted thoracic surgery (VATS) was expected to reduce PTPS based on the assumption that several small incisions, although at multiple intercostal levels are preferable to one long surgical incision. However, although minimally invasive, the use of VATS may not eliminate intercostal nerve injury since the scopes are heavily manipulated during the procedure, which may cause the nerve to be crushed against the adjacent rib [10]. VATS strongly reduces patient postoperative pain, hospital stay and analgesic requirements when compared to open surgery; however, over 50% of patients treated by VATS for spontaneous pneumothorax, complain of post-operative chest wall paresthesia related to the portal sites [11].

Intensity and duration of pain during the first postoperative day: Chronic pain after thoracotomy is associated with the intensity and management of acute pain after thoracotomy. The patients with intensive acute pain would experience intensive and long-term chronic pain [31].

Acute postoperative pain: Many studies have shown a correlation between severity of acute postoperative pain and CPSP. Aggressive treatment of early postoperative pain was the only factor that significantly reduced long-term pain [24].
The question of whether acute pain causes chronic pain has not been completely resolved, but some type of stimulus or continuous nociceptive process provides the impetus for chronic pain to develop [30].

Other factors: Other predictive factors for chronic pain included younger age (< 60 years), diabetes mellitus, acute post-operative pain and the duration of chest tube drainage [28]. Clinical conditions such as fibromyalgia syndrome, migraine, irritable bowel syndrome, irritable bladder, backache and Raynaud’s syndrome might also have an underlying genetic predisposition to the development of chronic post-surgical pain [30].

**Prevention**

Post-thoracotomy chronic pain occurs frequently and, without preventive measures, may affect more than 50% of patients [32]. Due to the fact that it is usually hard to treat, prevention is important [24].

Effective management of postoperative pain: It is interesting that severe acute postoperative pain is consistently found to be a risk factor for chronic pain across many studies. Many studies have shown a correlation between severity of acute postoperative pain and CPSP [24].

Anaesthesia and analgesia: The impact which an anaesthetic technique has on the long term effects of PTPS is unclear [25]. Various regional anaesthetic techniques have been used as part of a balanced anaesthetic technique to provide adequate intraoperative and postoperative analgesia. The techniques that have been tried successfully are intercostal nerve blocks, interpleural block, cryoanalgesia, paravertebral block and thoracic epidural, paravertebral block, IV narcotics, intrathecal or epidural narcotics, NSAIDS and transcutaneous nerve stimulation [21, 25]. Anaesthetic techniques that achieve this should show a reduction in both postoperative pain and chronic pain [24]. It is not surprising that the evidence for the effect of different anaesthetic and analgesic regimens on chronic pain show benefit from regional anaesthesia, for example, after hysterectomy, Caesarean section, iliac crest bone harvesting and thoracotomy. However, there are also studies that have shown no such benefit [24]. It has been suggested that the incidence of chronic pain after thoracotomy can be reduced through effective regional anaesthesia [26]. Thoracic epidural analgesia has greatly improved the pain experience and its consequences and has been considered the ‘gold standard’ for pain management after thoracotomy [21].

**Conclusion**

Pain-related problems account for up to 80% of visits to physicians. The epidemiological significance of chronic pain after surgery is enormous [30]. Management of thoracotomy pain can be difficult but the benefits of effective pain control are significant [33]. It represents a double challenge, not only because acute pain treatment must be optimal to allow for good short-term rehabilitation, but also to prevent the occurrence of chronic pain [32].

Current knowledge of surgical risk factors for PTPS is almost entirely based on non-randomised clinical trials and relative low-quality randomized clinical trials [10]. We may not be currently fully in a position to understand the causes of CPSP but we can still try to develop strategies to reduce its incidence [24]. There is clearly a need for education of the medical profession and the general public about the problem. If all involved parties
were aware of the risks, patients could be prevented from undergoing inappropriate or unnecessary surgery [24].

References

33. Soto, R.G and Fu, E.S. Acute Pain Management for Patients Undergoing
Amprachim S. E. et al: Factors Associated with Chronic Post-Thoracotomy Pain