Post-Thoracotomy Pain Syndrome: Assessment and Intervention

Kathleen Garrubba Hopkins, MS, RN, and Margaret Rosenzweig, PhD, APN-BC, AOCNP®

Surgery is a cornerstone of treatment in early-stage non-small cell lung cancer. Chronic postoperative thoracotomy pain, post-thoracotomy pain syndrome (PTPS), is a condition occurring in 50% of postsurgical patients with lung cancer and is largely unrecognized. This article examines the diagnosis and treatment of PTPS to assist oncology nurses in providing better care to this patient population. Post-thoracotomy pain in patients with lung cancer may be under-reported and undertreated. Causes from the thoracotomy can be trauma and compression to the intercostal nerves, fractured and compressed ribs, inflammation of the chest muscles, atrophy of chest muscles, or scar tissue rubbing. This article examines the diagnosis and treatment of PTPS to assist oncology nurses in providing better care to this patient population. If left untreated, chronic pain can have a deleterious effect on patients’ recovery and overall well-being. Oncology nurses should be aware of the signs and symptoms of PTPS so that more patients are diagnosed and choose to seek treatment.

The American Cancer Society (2012) reported 160,340 estimated deaths from lung and bronchus cancer, more than breast, colon, ovarian, and prostate cancers combined. In an attempt to surgically remove a lung tumor, many patients will undergo one of the following types of thoracotomy: traditional posterolateral, thoracoscopic, and posterolateral muscle-sparing.

In a traditional posterolateral thoracotomy, the patient is placed in the lateral position on the nonaffected side and the arm of the affected side is positioned anteriorly away from the incision site. An incision is made through the chest wall to remove the affected portion of lung. The incision typically passes through the major chest muscles, fourth and fifth rib intercostal spaces, and pleural and appropriate lobe where the surgeon removes the diseased portions of the affected lobe of the lung. Often during this procedure, to gain access to the thoracic cavity, the ribs are spread apart (Landreneau et al., 1994), which may cause damage to the ribs, intercostal nerves, and nerve bundles (Wildgaard, Ravn, & Kehlet, 2009). The procedure frequently results in damage to the latissimus dorsi muscle and less frequently to the serratus anterior muscle (Benedetti et al., 1998; Landreneau et al., 1994; Perttunen, Tasmuth, & Kalsol, 1999).

Thoracoscopic surgery also is called video-assisted surgery or robotic surgery, which includes three to five two-inch incisions where endoscopic instrumentation passes through the major chest muscles, intercostal spaces of the ribs, and pleural cavity. Endoscopic instrumentation includes a series of thoracoscopes, as well as several flexible or curved instruments with various holding and cutting ends specifically designed to remove the appropriate portions of the affected lobe of the lung. Even with this less invasive technique, the removal of the tumor can damage the ribs and nerves. However, once healed, the only visual reminders are the three to five two-inch scars (Landreneau et al., 1994; Perttunen et al., 1999; Wildgaard et al., 2009).

Another technique, posterolateral thoracotomy, is called muscle-sparing thoracotomy because access to the pleural cavity is obtained by entering through the fifth or sixth intercostal space, where obstruction of the major chest muscles is minimal. That approach results in a 6–10 inch scar on the lateral side, external to the larger fifth and sixth intercostal space region (see Figure 1).
With this technique, damage to the latissimus dorsi and serratus anterior muscles is spared (Benedetti et al., 1998; Landreneau et al., 1994; Perttunen et al., 1999).

Regardless of the type of thoracic surgery, four subcategories of lung surgery exist depending on the amount of lung the surgeon removes: wedge, segmentation, lobectomy, and pneumonectomy. Wedge is the surgical name given when a wedge-shaped portion of the lung, containing the tumor and potentially affected area, is removed. Segmentation is the surgical removal of a major portion of a single lobe. Lobectomy is the surgical procedure that removes an entire lobe, which is performed when either one large nodule or several small nodules are limited to one lobe. If the tumor has invaded the entire lung, a pneumonectomy is performed and includes closing the bronchial stump on the affected side after the removal of the entire affected lung. Boffa et al.’s (2008) surgical study of 9,035 participants in the Society of Thoracic Surgeons database showed the diversity of the four surgical procedures, with 6,399 (71%) lobectomies (single and double), 1,649 (18%) wedge, 591 (7%) pneumonectomies, and 394 (4%) segmentations performed.

In addition to surgery, the thoracic cavity also must endure trauma because of the use of postoperative chest tubes and other drainage devices. Subsequently, 10%–80% of all post-thoracotomy patients with lung cancer will have some form of post-thoracotomy pain syndrome (PTPS) (Karmakar & Ho, 2004).

**Post-Thoracotomy Pain Syndrome**

PTPS has been reported in the literature since the mid-20th century. During World War II, while reviewing thoracotomy-based sharpnel wounds in soldiers, a U.S. Army surgeon noticed several of his patients were reporting chronic or persistent pain along their post-thoracotomy surgical sites (Blades & Dugan, 1944). By 1986, the International Association for the Study of Pain (IASP) Subcommittee of Taxonomy had refined and defined PTPS as pain not related to metastasis or other treatments that recur or persists along a thoracotomy scar at least two months following the surgical procedure. Karmakar and Ho (2004) reported PTPS as a chronic condition that occurs at least two months post-thoracotomy, is seen in about 50% of patients, is a combination of neuropathic and non-neuropathic pain, commonly is caused by trauma to the intercostal nerves during thoracotomy, and typically includes more than one form of therapy to control pain. PTPS may not be caused only by the thoracotomy, but also may be rooted in nerve damage resulting from drainage mechanisms such as chest tubes and Jackson-Pratt tubing (Benedetti et al., 1998; Landreneau et al., 1994; Perttunen et al., 1999; Rogers & Duffy, 2000). However, any instruments or drainage devices passing through the network of intercostal nerves can cause nerve damage resulting in long chronic neuropathic pain (Kopf & Patel, 2010).

Dajczman, Gordan, Kreisman, and Wolkove (1991) published the first PTPS review in the nursing literature, interviewing 56 patients concerning long-term (1–4 years) post-thoracotomy incisional chest pain. That longitudinal study of patients with lung cancer reported that 30 participants (54%) had persistent pain for a median of 19.5 months after surgery. In addition, 24 of 44 participants (55%) reported pain more than one year after surgery, 13 of 29 (45%) reported pain for more than two years, 6 of 16 (38%) reported pain for more than three years, and 3 of 10 (30%) reported pain for more than four years post-thoracotomy (Dajczman et al., 1991). Dajczman et al. (1991) and Landreneau et al. (1994) noted that patients may not report PTPS unless it is of sufficient intensity and duration, which may account for the seemingly large variations in reported incidence.

Patients with lung cancer who have undergone thoracotomy may experience other side effects, including infection at surgical sites, shortness of breath, dyspnea, fatigue, and depression. Because of the comorbidities of lung and cardiac disease among this population, those causes can be reasonably eliminated as a pain source. Patients with lung cancer not only experience the surgical trauma of their disease treatment; they also experience several physiologic, psychological, and social changes because of the disease process (Demmy et al., 2009; Gray, 2008; Landreneau et al., 1994; Williams, 2006). Sarna et al. (2010) noted that in 119 women with lung cancer, PTPS often coexisted with dyspnea (21%) and depression (29%) six months after surgery. The patient’s overall pain experience can be from treatment or tumor (Eaton, Tipton, & Irwin, 2009). PTPS is from the surgical treatment and not metastatic in origin; therefore the patient’s pain must be evaluated. The evaluation of PTPS includes the elimination of confounding pain from metastatic disease and neuropathy from chemotherapy (Eaton et al., 2009).

**Cause and Pathology**

PTPS is recognized as pain resulting from the installation of therapeutic chest drains and not from surgery alone (Kopf & Patel, 2010). Therefore, the specific surgical and postsurgical causes of PTPS include (a) trauma and compression to the intercostal nerves during surgery, (b) fractured and compressed ribs caused by spreading of the ribs during surgery, (c) inflammation of the chest muscles and adjacent structures to the incision, (d) atrophy of chest muscles, and (e) scar tissue rubbing the pleural cavity structures.

Trauma and compression to the intercostal nerves: PTPS is often neuropathic in presentation and cause, which results from...
Atrophy, or muscle wasting, of the
Perttunen et al. (41x617)

Treatment of surgery. The areas of resulting inflammation and
damage can include the chest wall muscles, ribs, nerves, and
pulmonary linings of the lungs (Benedetti et al., 1998; Perttunen
noted that some patients were incapacitated by the inflamma-
tion. Therefore, while doing an assessment, healthcare providers
must be aware that even the gentlest stimulation could provoke
intense and disabling pain.

Atrophy of chest muscles: Atrophy, or muscle wasting, of the
chest muscles can occur in any thoracic surgery procedure
because of the rib spreading. Atrophy of the latissimus dorsi
and inferior portion of the serratus anterior muscle can present on
a computed tomography scan as a marked decrease in size or
thickness of a muscle on the surgical side compared with the
muscle on the nonsurgical side (Frola et al., 1995).

Scar tissue rubbing the plural cavity structures: Perttunen et al.
(1999) reported that 50% of patients who undergo lung resec-
tory experience PTPS and often describe long-term pain around
the wound or thorax. Patients note that the pain is an aching,
tenderness, or numbness. Perttunen et al. (1999) expanded de-
scriptions of scar pain to include sleep disturbances in 25%–30%
of patients. The major aggravating PTPS factors that patients
reported were carrying heavy objects, changes in the weather,
feeling depressed, lying on the operated side, sitting, walking
around, and working with the hand of the operated side (Pert-
tunen et al., 1999).

Diagnosis

In Boffa et al.’s (2008) study of more than 9,000 lung cancer
surgeries from 1999–2006, the average patient with lung cancer
was Caucasian (87%). Gender almost was equal, but comorbidi-
ties were present in 79% of the population including hyperten-
sion (66%), coronary artery disease (26%), obesity (26%), and
diabetes mellitus (13%). Additional preoperative characteristics
included median tobacco smoking at 45 pack years, body mass
index of 26.4 (normal 18–25), and forced expiratory volume
of 77.5% (normal 80%–100% of the predicted value) (Boffa et
al., 2008).

The first step in the evaluation and, later, management of PTPS
consists of gathering a medical history. The detailed medical his-
tory should include the traditional components of the patient
history, as well as specific procedures that have been used in
the diagnosis and surgical interventions.

If the patient visit is at least two months postsurgery, the
incisional sites should be appropriately healed. Patients with
possible PTPS typically note sensations using traditional neural
pathic descriptors either at the incision site or radiating along
the surgical neuropathic pathways from the spine to the ster-
um and near the surgical incision site (Perttunen et al., 1999).
A detailed description of the symptom should include onset,
location, characteristics, aggravating factors, alleviating factors,
and timing.

Despite the high incidence, not all patients readily discuss
their pain (Perttunen et al., 1999). The simplest method of

nerve damage caused by surgical compression of intercostal
nerves because of instruments and rib spreading during surgery
(Benedetti et al., 1998; Landreneau et al., 1994; Perttunen et
al., 1999; Wildgaard et al., 2011). The common presentation
is pain along the intercostal nerve pathway from the spine to
the sternum. Pain typically is described as a dull, prickly, cool,
tingling, or itchy sensation with no obvious external source
(Perttunen et al., 1999).

Fractured and compressed ribs because of spreading: A common
presentation of PTPS is severe pain radiating along the location
of the removed, fractured, or spread rib site to the sternum.
Landreneau et al. (1994) showed that no difference in postsurgi-
cal pain medication requirements exists between thoracotomy
and the less evasive thorascopic procedures during the first year
of surgery.

Inflammation of the chest muscles and structures adjacent to the
incision: This inflammation can result from surgical and postsurgi-
cal causes. The postsurgical causes include chest tubes and
drainage tubing (Benedetti et al., 1998; Perttunen et al., 1999;
Rogers & Duffy, 2000). The areas of resulting inflammation and
damage can include the chest wall muscles, ribs, nerves, and
pulmonary linings of the lungs (Benedetti et al., 1998; Perttunen
noted that some patients were incapacitated by the inflamma-
tion. Therefore, while doing an assessment, healthcare providers
must be aware that even the gentlest stimulation could provoke
intense and disabling pain.

Case Study: Post-Thoracotomy Pain
in a Postsurgical Patient With Lung Cancer

A.C. is a 62-year-old married Caucasian man who
works full-time and lives in an urban setting. He has
smoked two packs of cigarettes a week for 20 years and recently quit.
He has a medical history of chronic obstructive pulmonary disease and
arterial sclerosis. Otherwise, he is in good health. His current medica-
tions include metoprolol (25 mg twice daily), aspirin (81 mg daily), and
fluticasone and salmeterol (250/50 mcg inhaler, one puff twice daily).
A.C. developed the H1N1 flu with resultant upper-
respiratory infection. The persistent infection was
confirmed radiographically using a positron-emission tomography/
computed tomography (CT) scan. The scan also revealed a 5 cm mass in
the upper lobe of his right lung as a possible lung cancer. He underwent
a right posterior-lateral thoracotomy to remove his right upper lobe in
addition to a 5 cm mass with clear margins and five lymph nodes. The
incision was surgically closed with two #28 chest tubes, one placed
anteriorly and one posteriorly in an upward fashion, which were sutured
in place. The pathology report confirmed a positive diagnosis of stage
II non-small cell lung cancer, associated with a history of smoking. No
internal pleural cavity (visceral pleural) invasion or extensive vascular
invasion was identified. All five of the removed lymph nodes were
negative for metastatic carcinoma. Adjuvant chemotherapy was given.

At A.C.’s one-year postoperative visit, his vital signs
were stable and he had no new medications. The cli-
nician reviewed his annual CT, which showed no evidence of recurrent
disease or new nodules. However, some right-sided muscle atrophy
did exist. On a routine symptom assessment form, A.C. ranked his pain
(PTPS) as a 6 out of 10 at its worst, radiating from his back, through his
surgical area and described the pain as continuous and radiat
ing from the left lower base of the scapula along the ribs and lateral
position of the surgical scar. The rating was not addressed. A.C. worked
full-time at the local hardware store where he walked about six miles a
day and often moved and lifted objects ranging from 25–50 pounds. He
blamed the pain for his decreased activity, mild anxiety, and depression.
The clinician noted that the scar tissue was well approximated with no
swelling or redness. A.C. flinched during the physical examination to the
wound or thorax. Patients note that the pain is an aching,
tenderness, or numbness. Perttunen et al. (1999) expanded de-
scriptions of scar pain to include sleep disturbances in 25%–30%
of patients. The major aggravating PTPS factors that patients
reported were carrying heavy objects, changes in the weather,
feeling depressed, lying on the operated side, sitting, walking
around, and working with the hand of the operated side (Pert-
tunen et al., 1999).

Diagnosis

In Boffa et al.’s (2008) study of more than 9,000 lung cancer
surgeries from 1999–2006, the average patient with lung cancer
was Caucasian (87%). Gender almost was equal, but comorbidi-
ties were present in 79% of the population including hyperten-
sion (66%), coronary artery disease (26%), obesity (26%), and
diabetes mellitus (13%). Additional preoperative characteristics
included median tobacco smoking at 45 pack years, body mass
index of 26.4 (normal 18–25), and forced expiratory volume
of 77.5% (normal 80%–100% of the predicted value) (Boffa et
al., 2008).

The first step in the evaluation and, later, management of PTPS
consists of gathering a medical history. The detailed medical his-
tory should include the traditional components of the patient
history, as well as specific procedures that have been used in
the diagnosis and surgical interventions.

If the patient visit is at least two months postsurgery, the
incisional sites should be appropriately healed. Patients with
possible PTPS typically note sensations using traditional neuro-
pathic descriptors either at the incision site or radiating along
the surgical neuropathic pathways from the spine to the ster-
um and near the surgical incision site (Perttunen et al., 1999).
A detailed description of the symptom should include onset,
location, characteristics, aggravating factors, alleviating factors,
and timing.

Despite the high incidence, not all patients readily discuss
their pain (Perttunen et al., 1999). The simplest method of
assessment is to ask patients whether they have any pain or discomfort in the area of the surgery or location of the scars (Chapman, 2011; Williams, 2006). Verbal pain descriptors and defects in motor function patterns of the upper extremity near the surgical site can help in the diagnosis of PTPS, and several tools have been used to assess neuropathic pain (Melzack, 1975, 1987). Healthcare professionals should begin with a general assessment and then focus on the surgical site, identifying any abnormal tenderness, redness, or swelling (Galer & Jensen, 1996; Melzack, 1975, 1987; Williams, 2006). Clinicians can use the findings and additional testing to rule out abnormalities related to metastasis or infection.

Asking patients about their pain has been proven both reliable and valid (Eaton et al., 2009) and allows clinicians to quickly identify whether PTPS has developed (Backonja & Kraus, 2003; Galer & Jensen, 1996; Williams, 2006) (see Figure 2). Patients may not identify PTPS as pain and, if not, the clinician should ask them if they have noted a sensitivity to touch or a weird or funny feeling in the scar area (Galer & Jensen, 1996; Williams, 2006).

Severe PTPS descriptors ranged from an occasional or constant shooting or pinching sensation to a recurrent cramping, cutting, or stabbing sensation (Williams, 2006). Patients may complain that anything touching the surgical scar area, including clothing or even bed sheets, makes the pain worse (Williams, 2006). Moderate PTPS has been noted as a dull, prickly, cool, tingling, or itchy sensation, often with no obvious external source (Gray, 2008; Williams, 2006). Mild PTPS has been described by patients as a funny feeling or numbness (Benedetti et al., 1998).

PTPS should be distinguished from other pain associated with the cancer experience because, like other neuropathic pain, PTPS can be chronic without a specific trigger or activated by simple touch and increased movement (Gray, 2008; Williams, 2006). Clinicians should investigate patients’ PTPS aggravating factors. Failure to do so often can lead to increased PTPS, as well as increased anxiety and depression (Gray, 2008; Williams, 2006). PTPS, like pain, can be aggravated by other comorbidities, including anxiety, depression, fatigue, and dyspnea (Williams, 2006).

Differential Diagnosis

An appropriate physical examination should include palpation of the surgical area and movement of the arm on the affected side. During palpation, check for skin sensitivity that can range from numbness and tingling to pain at the scar or along the intercostal nerve line. For appropriate arm movement, locate the affected side and move the arm in both a lateral and rotating motion, checking for discomfort and pain. That motion is important because raising or turning pulls and distorts the muscles, ribs, and plura. To fully assess nerve damage in the thoracic muscles, the clinicians’ physical assessments should not only include palpations of the scar region, but also flexion and extension of the arms and chest.

Management of Post-Thoracotomy Pain Syndrome

Medications

Severe PTPS is typically treated first with opioids (Chan et al., 2009; Demmy et al., 2009). However, because PTPS pain often is neuropathic in origin, opioids alone frequently are ineffective or only give partial relief (Williams, 2006). Therefore, when the patient is not responding to correctly calibrated opioids, the clinician may need to prescribe anti-inflammatory drugs, antidepressants, anticonvulsants, gabapentin, or steroids (Lickiss, 2001). Few randomized controlled trials (RCTs) have investigated medications in the treatment of PTPS, and even fewer have noted an effective treatment. Therefore, this review includes both RCTs and non-RCTs for neuropathic treatments in other populations, such as patients with neuropathic pain with diabetes or postchemotherapy.

A Cochrane database review provided some evidence that antidepressants and anticonvulsants are the main treatment for neuropathic pain in other populations. Additional studies identified serotonin and norepinephrine (noradrenaline) reuptake inhibitors as a well-established treatment for chronic neuropathic pain (Mattia, Paoletti, Coluzzi, & Boanelli, 2002; Sindrup, Otto, Finnnerup, & Jensen, 2005) and, therefore, may be considered when prescribing for PTPS. In two systematic reviews of an RCT (Gilron, 2007; Tiippana, Hamunen, Kontinen, & Kalso, 2007), neuropathic medications such as gabapentin were suggested as possible treatments to reduce peripheral neuropathy including PTPS. Growing evidence suggests that stress can enhance neuropathic pain symptoms in postsurgical populations (Dulá et al., 2011); in addition, hormonal responses caused by stress aggravate neuropathic pain (Alexander, DeVries, Kigerl, Dahlman, & Popovich, 2009).

For moderate PTPS, the opioid drugs, with morphine as the gold standard, should be used appropriately (Lickiss, 2001; Perttunen et al., 1999). However, traditional nonsteroidal anti-inflammatory drugs (NSAIDs) may be an appropriate choice, particularly for older patients with moderate or mild pain (Lickiss, 2001; Perttunen et al., 1999; Williams, 2006). If NSAIDs are ineffective, then tramadol often is prescribed (Hollingshead, Dühmeke, & Cornblath, 2006). Hollingshead et al.'s (2006) systematic review of 64 RCTs reported that eight showed tramadol to have a significant effect on neuropathic pain, particularly for paracentesis, alldynia, and touch-evoked pain.

Mild PTPS often is treated with traditional over-the-counter NSAIDs (e.g., aspirin, ibuprofen, naproxen) (Lickiss, 2001; Williams, 2006). Cyclooxygenase-2 inhibitors such as celecoxib also may offer relief (Lickiss, 2001).
Alternative Medicine Techniques

Acupuncture has not been proven effective for pain relief in an RTC; however, the IASP has recommended acupuncture and intercostal nerve block as treatments for PTPS (Deng et al., 2008; Kopf & Patel, 2010).

Implications for Nursing

Most research regarding pain in lung cancer has been limited to patients with metastatic disease and not on the experiences of patients undergoing potentially curative surgical treatment (Daiczm, 1991; Landreneau et al., 1994). Research shows that more than 50% of postsurgical patients with lung cancer have PTPS. However, clinicians have limited time to assess, diagnose, and treat postsurgical patients with lung cancer. Increased awareness among oncology nurses may bring more patients to treatment of this chronic pain condition.

References

For Exploration on the Go

The Oncology Nursing Society offers a site-specific cancer series online course on lung cancer. Find out more information on this course by opening a barcode scanner on your smartphone. Point your phone at the code and take a photo. Your phone will link to the content automatically.


Receive Continuing Nursing Education Credits

Receive free continuing nursing education credit* for reading this article and taking a brief quiz online. To access the test for this and other articles, visit http://evaluationcenter.ons.org/Login.aspx. After entering your Oncology Nursing Society profile username and password, select CNE Tests and Evals from the left-hand menu. Scroll down to Clinical Journal of Oncology Nursing and choose the test(s) you would like to take.

* The Oncology Nursing Society is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center’s COA.