

Intercostal Neuralgia

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Continuing Education Activity

Intercostal neuralgia encompasses any painful condition of the intercostal nerves. There are a variety of causes of intercostal neuralgia which cause significant rib, chest, and/or upper abdominal wall pain. Intercostal neuritis is inflammation of the intercostal nerves. This activity describes the evaluation and management of intercostal neuralgia and reviews the role of the healthcare team in improving care for patients with this condition.

Objectives:

- Outline the pathophysiology of intercostal neuralgia.
- Describe the presentation of a patient with intercostal neuralgia.
- Summarize treatment modalities available for treating intercostal neuralgia.
- Describe the importance of improving care coordination among the interprofessional team to enhance care for patients affected by intercostal neuralgia.

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Introduction

Intercostal neuralgia is characterized by neuropathic pain in the distribution of affected intercostal nerve(s) (along the ribs, chest, or abdomen) that commonly manifests as a sharp, aching, radiating, burning, or stabbing pain and may be associated with paresthesia such as numbness and tingling. The pain may be intermittent or constant and typically presents either as a band-like pain wrapping along the chest and back or in a thoracic dermatomal pattern. Pain may last for a prolonged period and may continue long after the inflicting disease process has subsided.[1]

Symptoms are typically sensory in nature, with severe cases having motor function affected as well. While there are multiple causal mechanisms of the disease, the pain transmission pathways remain the same, leading to similarities in treatment approaches.

Etiology

A variety of different mechanisms can cause direct or indirect intercostal nerve injury leading to inflammation. Probably the two most documented and common causes of intercostal neuritis/neuralgia are thoracic wall tissue and nerve damage from thoracotomy (both in the acute phase and chronic phase, a condition known as post-thoracotomy pain syndrome [PTPS]) and herpes zoster (HZ) infection (both in the acute reactivation phase and chronically—a condition known as post-herpetic neuralgia [PHN]). Nevertheless, there are many other less common etiologies, including traumatic injury, iatrogenic (after chest tube placement or surgical procedure like mastectomy or other breast surgery), anatomical compression, pregnancy, inflammatory/reactive, infectious, or neoplastic, to name a few.[2][3]

Epidemiology

As the term intercostal neuralgia is an umbrella term incorporating multiple distinct pathological processes, the exact frequency of its overall occurrence is difficult to ascertain. The University of Maastricht estimates that between 3 to 22% of pain clinic referrals are due to thoracic pain, and its overall prevalence in the general population is about 15%. One study investigated a subset of patients who had intercostal neuropathy and found that 43% were related to surgical intervention, 28% were post-herpetic, while the rest were idiopathic or neoplastic in origin.[4]

Importantly, intercostal neuritis at levels below T7 can manifest as chronic abdominal wall pain, which prompts investigation of possible surgical causes and unnecessary abdominal surgical interventions. Since intercostal neuritis in such cases is a diagnosis of exclusion, estimation of prevalence becomes complicated.

PTPS is defined by the International Association for the Study of Pain (IASP) as ‘pain that recurs or persists along a thoracotomy incision at least two months following the surgical procedure.’[5] It has received much study, and estimates of its prevalence vary anywhere from 25 to 80%, with most studies averaging in the 50% range.[6][7][8][9][10][11][12][13][14] The Society of Thoracic Surgeons: General Thoracic Surgery Database recorded at least 42,486 thoracic surgeries performed between July 2017 and June 2018. Considering that over 40,000 thoracotomies take place in the US each year, if approximately half of those patients develop PTPS, one could assume approximately 20,000 new cases annually, making PTPS a significant source of intercostal neuralgia.[14]

HZ most commonly affects thoracic dermatomes.[15] It has an increased incidence with increasing age and tends to affect women about 1.5 times more often than men. The overall lifetime incidence of HZ is somewhere around 30%, and of that, approximately 10 to 20% will develop PHN.[16][17][18][19][20][21] Moreover, despite the availability of a vaccine, a study in 2015 still found the annual incidence of HZ to be 10.46 per 1000 person-years in those 60 and older.[22]

Given that thoracic surgery and HZ infection are predominant among the elderly, intercostal neuralgia also predominantly develops in this population yet can affect any age group who suffer inciting insults to the intercostal nerves.

Pathophysiology

The pathophysiology of intercostal neuralgia is multifactorial and includes various combinations of the peripheral and central nervous system and psychological mechanisms. An anatomic or inflammatory source can be found in some instances, yet many patients have disorders in which the etiology is unclear.

In the case of induced trauma, such as thoracotomy, thoracostomy or thoracostomy tube placement, breast surgery, positioning injury, rib fractures, nerve impingement, and similar, the source is either direct damage to the nerve or the structures surrounding it with resulting inflammation and/or nerve entrapment (secondary to scarring or inflammation). There may also be atraumatic cases of intercostal nerve entrapment, for example, in the case of anterior cutaneous nerve entrapment syndrome (ACNE) in which the lower intercostal nerves (T7-T11) and/or subcostal nerves (T12) become entrapped, most commonly at the most lateral aspect of the rectus abdominis muscle where the nerves take a 90-degree turn.

Infectious or reactive processes may also lead to intercostal neuralgia, for example, HZ, pleuritis, and diabetic peripheral neuropathy. In the case of an infective source, such as HZ, there is damage to the nerve both from the infective source and then from the immune response to clear such infection. Specifically, in HZ infection, the underlying pathophysiology is re-activation and replication of the previously dormant HZ virus in the dorsal horn and its movement down the nerve and affected dermatome.[21] Such inflammation or direct trauma leads to cytokine release and removal of myelin, leaving the axolemma exposed and causing inappropriate upregulation and activation of ion channels. As a result, there are dysregulated and inappropriate action potentials generated, resulting in pain.[23][24] This condition, with time, can lead to central sensitization and, later, the development of aggravating psychosomatic components.

Stretching of the nerves may lead to intercostal neuropraxia, which can occur in pregnancy. Ascites, obesity, recurrent and frequent coughing, and surgical retraction may also contribute to tension injury.

History and Physical

When a patient presents with thoracic or upper abdominal pain, a thorough history and physical is of paramount importance. Intercostal neuralgia pain will typically follow a distribution along the affected dermatome or in a band-like pattern, often perceived as pain, tightness, stabbing, aching, and/or burning along the rib(s), chest and/or back, and/or upper abdomen. This pain may also be described as (or associated with) paresthesias such as numbness and tingling. Many times, especially with PHN, patients may endorse significant allodynia along the painful region.

Pain may be dramatically exacerbated by physical activity or unexpected movements, like a sharp turn of the torso, jumping, laughing, coughing, sneezing, or even breathing. Pain may be constant or intermittent. History of prior thoracic surgery, trauma, or HZ infection requires an evaluation, although intercostal neuralgia may occur without a known inciting incident.

On physical exam, the patient may endorse allodynia to light touch and/or hyperalgesia to pin-prick, described as stabbing or burning in quality, often accompanied by numbness in the distribution of one or more dermatomes corresponding to the intercostal nerve distribution.[23] [25] Involuntary contractions of individual muscles and color changes of skin above the affected area, as well as the loss of sensitivity over the affected dermatome, are also indicative of nerve damage. Palpation or stretching of the affected nerve(s) may reproduce pain.

One exam finding that may be positive in intercostal neuralgia is Schepelmann's sign; the patient will endorse increased pain upon lateral lumbo-thoracic bending toward the side of pain (compression of intercostal structures), whereas increased pain leaning away from the side may indicate pleuritic pain (distension of pleura).[26] In the case of ACNE syndrome, Carnett's sign may be positive (increased pain with palpation of the affected area during abdominal muscle engagement [ex: a partial sit up]).

If there is a history of prior thoracic surgery, then details of it and indication for surgery, along with timing and any potential complications, should be sought out. In the hospitalized post-thoracotomy patient, the history will be known, but it may require more in-depth investigation in other settings. Patients often describe post-thoracotomy pain as burning or stabbing with the dysesthesias localized to one or two adjacent dermatomes in the distribution of the affected nerve(s), correspond with the surgical site.[5][12]

Physical exam should include a thorough evaluation of any surgical scar and palpation of the affected area, eliciting signs of neuropathic pain. Similarly, blunt or penetrating chest trauma may also manifest in scar formation and analogous pain patterns. In HZ, patients may have a history of prior outbreaks or immunosuppression. The physical exam may show vesicular rash in the distribution of the affected dermatome acutely or possible scarring in cases of chronic (PHN) pain. Other pertinent history and workup include pregnancy and parity, autoimmune disorders, neoplastic process, or metabolic and nutritional derangements.

Evaluation

The diagnosis of uncomplicated intercostal neuralgia is based solely on history and physical exam. A diagnostic intercostal nerve block can aid in diagnosis. Although physical examination and history may be sufficient to elicit the diagnosis of intercostal neuralgia, in some cases, imaging may be indicated. In the event of trauma, roentgenography (X-ray) or computerized tomography (CT) may be useful in demonstrating compression or transection from a broken rib or foreign body. If a patient has had a thoracotomy for removal of cancer, thoracic pain may be a result of PTPS, but it may also be a sign of cancer recurrence and metastasis to the chest wall, and so CT or magnetic resonance imaging (MRI) may be indicated.[3][27]

In some cases, electromyography may be useful for evaluating the function of the intercostal nerves.[4][28][29] When evaluating a patient with suspected HZ, the history and physical exam with characteristic vesicular rash contained to one dermatome may be enough in clinical practice to make a diagnosis, but PCR or skin biopsy can be included in atypical cases to help fortify the diagnosis.[21][30] As this is a diagnosis of exclusion, it is important to rule out all cardiac, pulmonary, and/or gastrointestinal pathology as appropriate, with any indicated referrals, imaging, and/or diagnostic testing. For example, if the primary complaint is upper abdominal pain, abdominal ultrasound, CT, or referral to the specialist can help exclude the pathology of the underlying viscera.[31] Also, thoracic disc herniation causing thoracic radiculopathy should be considered and can be evaluated with a thoracic MRI.[32]

Treatment / Management

Given that intercostal neuralgia has many different causes, there are varying considerations regarding management; however, treatment of the intercostal neuralgia in and of itself remains similar and appears below after outlining unique factors.

When inciting factors can be identified, it is important to try to mitigate them. For example, if a patient has a chronic cough that may be contributing to this pain, perhaps a cough suppressant would prove beneficial.

Optimizing preventative strategies and mitigating the insulting etiologies, as well as the pain caused by those insults in the acute phase, can reduce the development of chronic pain.[33] For example, in the case of thoracic surgery, it is important to determine a preemptive and multifaceted plan for pain control, including neuraxial or peripheral blockade in combination with multimodal analgesic agents.[34] This can help achieve good analgesia acutely and thereby reduce the likelihood of PTPS development and improve pulmonary mechanics and function by reducing splinting.[35][36][37][38][39][40] Thoracic epidural placed before surgery has traditionally been the gold standard for achieving this

goal, although similar efficacy is achievable by using paravertebral nerve blockade.[34][41][42][43][44]

Another option is the intercostal nerve blockade.[45] Some have argued this may be a superior alternative to thoracic epidural if combined with a multimodal pain control regimen.[46] Also, opioids, nonsteroidal anti-inflammatory drugs (NSAIDs), anticonvulsants, topical medications (capsaicin, transdermal lidocaine), and transcutaneous electrical nerve stimulation (TENS) (if location and exam pose no contraindications) are mainstays of adjunctive therapy.[34][47][48] In the chronic setting of neuropathic pain, tricyclic antidepressants, selective serotonin reuptake inhibitors (SSRIs), selective norepinephrine reuptake inhibitors (SNRIs) are also options.[49][50]

In the case of HZ, many instances can be minimized or avoided if patients receive vaccination with the live attenuated vaccine. It has been demonstrated that the vaccine can reduce the incidence by around 51% and that of PHN by upwards of 66% while simultaneously reducing the burden of disease in the remaining cases.[51][52] As with PTPS, PHN is more effectively treated and prevented with a multimodal and preemptive approach.[53] Beyond preventative measures, antivirals of the nucleoside analog category such as acyclovir, especially if taken early in the HZ course of the disease, have been shown to reduce severity and duration of acute pain by inhibiting viral replication; however, the reduction in the development of PHN is less clear.[51][54][55]

Systemic corticosteroids have some modest effect on acute HZ symptoms but no reduction in the development of PHN.[56] Inclusion of neuraxial or peripheral anesthetic with or without steroids can further reduce acute pain and development of PHN, especially if administered early in HZ infection.[57] NSAIDs, antidepressants (especially TCAs, but SSRIs/SNRIs to a lesser extent),[53][58][53] anticonvulsants,[59][60] opioids,[61] topical agents,[62][63] and TENS [64] have all shown to be effective treatments options for both acute and chronic HZ pain.[65]

For pain control in the chronic phase of intercostal neuralgia in general, regardless of cause, medications including nonsteroidal anti-inflammatory drugs (NSAIDs), anticonvulsants (i.e., gabapentin, pregabalin), antidepressants (tricyclic antidepressants, selective norepinephrine reuptake inhibitors (SNRIs), or bupropion), and opioids may be helpful. Topical medications (i.e., low concentration capsaicin, transdermal lidocaine) may be helpful as well.[34][47][48]

A high concentration, 8% capsaicin patch may be applied topically in the clinic setting (requiring pre-placement topical or regional anesthetic placement) and is FDA approved for the treatment of PHN pain.[66] It has also shown potential promise in the treatment of PTPS based on a case report of 2 patients.[67] Transcutaneous electrical nerve stimulation (TENS) (if location and exam pose no contraindications) is a potentially helpful adjunctive therapy, although efficacy is questionable.[68]

Interventional techniques like intercostal nerve blocks can also be helpful in the diagnosis and treatment of intercostal neuralgia. If repeated intercostal nerve blocks using a local anesthetic (with or without steroid) provide reliable and significant, yet short-lived pain relief, then neurolytic intercostal nerve block with phenol or alcohol may be considered.[69][70][71] Multiple case reports advocate for the effectiveness of image-guided radiofrequency ablation of intercostal nerves, or even corresponding dorsal root ganglia, as a method of prolonged pain control.[72][73]

Another possible intervention can include manipulation of the thoracic spine to relieve impingement. When there is aberrant or impeded motion at one or more thoracic vertebrae, it can set off an inflammatory response and physically irritate the costal nerve(s). This is particularly possible if the costovertebral joint is involved, preventing appropriate rib excursion. Manual release of the intervertebral and costovertebral joints in the area can remove impingement in some cases, providing relief.[74][75]

More invasive options are surgical neurectomy, dorsal rhizotomy, or sensory ganglionectomy of corresponding intercostal nerves.[1][76][77][78][79] These methods are not used frequently due to the irreversibility of sensory, neurological deficits combined with unpredictable efficacy and potential for developing dysesthesias.

It is important to remember that the pain of intercostal neuralgia can lead to deconditioning as a result of avoiding physical activity. Physical therapy, psychotherapy, and acupuncture can be effective and synergistic additions to pharmacological and/or interventional treatments.

Differential Diagnosis

The differential diagnosis for pain in the thoracic region can be quite extensive. One method of categorization is traumatic vs. atraumatic and musculoskeletal/neuropathic vs. visceral. In the setting of trauma with pain localized to the chest wall, the possibility of rib fracture, soft tissue

(intercostal cartilage and muscle) damage, and vertebral compression fractures merit investigation.

Trauma can damage visceral organs, and thus aortic dissection, pulmonary contusion, hemo/pneumothorax, or pain referred from cardiac, pulmonary, or other visceral organ damage should be ruled out.

In atraumatic cases, musculoskeletal/neuropathic sources to be considered include pleurisy, costochondritis, Tietze syndrome, malignancy (primary or metastatic to spine or chest wall), and radiculopathy, to name a few. Visceral sources of pain, such as pulmonary embolism, myocardial infarction, and aortic dissection, should always be considered and ruled out. If the patient is complaining of upper abdominal pain, gastrointestinal causes should be ruled out.

Prognosis

The prognosis of intercostal neuralgia is variable. Some patients achieve resolution of symptoms over time with or without supportive conservative measures, while others develop chronic pain, which can be a significant source of morbidity.

Studies indicate that up to 5% of patients will develop severe chronic symptoms that are disabling and interfere with normal life after thoracic surgery.[9][13] One study showed a slow reduction in patients reporting symptoms of PTPS over several years, with 57% at 7 to 12 months, 36% at 4 to 5 years, and 21% at 6 to 7 years. Of those, approximately 40% had limitations in daily activity due to pain.[7] In general, patients who experience PTPS have decreased physical function and report lower quality of life.[6]

There is approximately a 30% lifetime risk of developing HZ infection, with most cases occurring in patients over the age of 50 and/or immunocompromised. The incidence of developing PHN after HZ infection is reportedly 5 to 30%, and risk factors include older age, prodrome, severe rash, and uncontrolled pain during HZ infection.[80][81] Patients with continued pain at six months following diagnosis of HZ are much more likely to have chronic pain lasting months-years.[82] The pain from PHN can be life-limiting, reducing activity, affecting sleep, and causing depression.[51]

Complications

Many complications may arise from intercostal neuralgia. As outlined previously, one major complication of acute intercostal neuralgia is a negative effect on respiratory mechanics.[40] This respiratory hindrance can be a significant contributing factor to mortality in the elderly, particularly post-surgical or immunocompromised patients with multiple comorbidities. Moreover, the burden of chronic pain and its effects on both psychological and physical health as a whole represents a significant challenge. Beyond the disease itself, the treatment options are not without risk.

Epidural analgesia entails the risk of spinal cord injury, inadvertent dural puncture, sympathectomy, hypotension, nausea, vomiting, urinary retention, infection, and bleeding, to name a few. Regional interventional techniques have many risks, including, but not limited to, damage to nerves or surrounding structures and local anesthetic toxicity. All pharmacological treatments have well-known side effects and possible reactions with other medications.

Opioids notoriously represent unique risks of addiction, respiratory depression, and diversion. All of these complications mark challenges in the care for patients with intercostal neuralgia.

Deterrence and Patient Education

Patients with intercostal neuritis are at significant risk of developing chronic intercostal pain. The population at risk is mostly those with trauma to the thoracic region, thoracic surgery, or HZ. Some of these risk factors are avoidable, like HZ, with the administration of a preventative vaccine. All patients at risk (those aged 60 and older, especially women and the immunocompromised) should receive the HZ vaccine as per CDC guidelines.[83][84] Moreover, those who do develop HZ infection should seek prompt medical treatment for antiretrovirals and acute pain control to mitigate the risk of PHN occurrence.

This article advocates for primary care providers to educate patients about the benefits of both the HZ vaccine and early treatment in HZ to minimize the incidence and morbidity of PHN. Moreover, providers should be aware of the signs and symptoms of intercostal neuralgia of all

origins and be able to educate and provide patients with treatment alternatives. The development of PTPS can be mitigated by utilizing effective pre- and post-operative analgesia techniques, like epidural or paravertebral blocks, and adequate pharmacological therapy.

Enhancing Healthcare Team Outcomes

Intercostal neuralgia can present as acute or chronic pain and can originate from multiple etiologies. This variability in its presentation and etiology highlights the challenge and importance of good communication and care coordination between multiple healthcare professionals. Nurses perform crucial tasks in treating patients with intercostal neuralgia.

Maximizing utilization of incentive spirometry, mobilizing patients, recognizing pain and achieving adequate pain control, educating patients, and notifying clinicians (MDs, DOs, MPs, PAs, DCs), pharmacists, and other members of the healthcare team of any issues that may arise all have a profound effect on the course of the disease. Similarly, physical and occupational therapists play a key role in both inpatient and outpatient theaters in making sure the patient is as active and adaptive as possible. Utilizing the interprofessional model will render available treatment options available, depending on the precise etiology, and drive better patient outcomes. [Level 5]

Pharmacists play a critical part in ensuring the patient is on the appropriate medication regimens and dosing, especially regarding antibiotics, antivirals, and analgesia. In the acute phase of intercostal neuralgia caused by surgery, the thoracic surgeon or intensivist in the ICU setting must recognize and address the pain properly. Consulting an acute pain service early to incorporate regional or neuraxial analgesia can minimize pain, thereby improving post-operative pulmonary mechanics and reducing the likelihood of developing chronic PTPS.[35][37][38] [Level 2]

In the event of acute HZ infection, the primary care provider (in the outpatient setting) or hospitalist (in the inpatient setting) must recognize the signs and symptoms and treat the condition with adequate analgesia and antivirals. Consultation of infectious disease specialists or pharmacists may provide insight into the best treatment regimen for these patients. Perhaps one of the most consequential roles is that of the primary care provider in encouraging patients to receive the zoster vaccine, which has been shown to prevent the development of HZ, reduce symptoms of HZ, and the likelihood of development of PHN.[52] [Level 1] In the event of chronic pain secondary to intercostal neuralgia, the involvement of a chronic pain specialist is warranted.

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