The innervation of the thorax and its contents is complex with considerable entanglement by the afferent components of the associated sympathetic and parasympathetic systems. Further ambiguity related to the sensation and localization of pain arises through the merging of sympathetic and somatic fibers at the spinal cord. The projection of the sensory portion of the phrenic nerve to the cervical segments of the spinal cord and its mingling with sympathetic fibers of the stellate ganglion also leads to clinically meaningful disparities between sensation and the sources of nociceptive input.

The heart, pericardium and the esophagus are innervated by both vagal-parasympathetic and sympathetic afferents. Sympathetic fibers supplying the upper portion of the esophagus travel with those innervating the heart and pericardium. Both vagal and sympathetic afferents are sensitive to mechanical and chemical stimuli, though the sympathetic system is thought to encode the majority of noxious input. For the lungs the intercostal nerves supply the costal and peripheral portions of the diaphragmatic pleura, whereas the phrenic nerve supplies sensation to the central portion of the diaphragmatic pleura and the mediastinal pleura. The vagus innervates much of the trachea-bronchial tree. The importance of the afferent component of the phrenic nerve is reflected by the fact that its blockade alleviates the shoulder pain often experienced after thoracotomy. It is unclear if the visceral pleura can trasduce pain, but the parietal pleura is clearly sensitive to mechanical and chemical stimuli (especially acid).

Thoracotomy can be one of the most painful types of surgery that patients can experience. We studied 120 subjects undergoing thoracotomy who were treated with aggressive patient controlled thoracic epidural analgesia (bupivacaine 0.5 mg/ml and fentanyl 5 micrograms/ml) and non-steroidal anti-inflammatory drugs (NSAIDs). In the hospital, their mean “worst pain over 24 hours” (e.g. coughing) was 5.5 out of 10, and their mean “average pain over 24 hours” was 3.2 out of 10. Such high levels of acute pain in the face of a properly functioning epidural with other multimodal analgesics increase the risk of pulmonary complications and the development of chronic pain.

With the exception of the pain syndromes associated with limb long-term post thoracotomy pain syndrome may be among the most highly recognized surgery specific pain syndrome. In our study, pain levels among subjects did not decrease during hospitalization, and remained nearly as severe 4 weeks after the surgery. Several studies indicated that more than half the patients who undergo open thoracotomy will continue to experience pain one year following surgery. Risk factors for developing long-term post-thoracotomy pain are thought to include female sex, chest wall resection, and high levels of in-hospital pain. At least 50% of chronic post thoracotomy pain seems to be neuropathic in origin. Thus, the phenomena of post-
thoracotomy pain syndrome is quite complex because it involves somatic nerves (intercostals – accounting for neuropathic pain), visceral nerves (phrenic and vagus), pre- and postoperative oncologic intervention, psychological impact of cancer and other concomitant diseases.

Seventy-seven thousand thoracotomies were performed in North America in 2007. As a result, there may be up to 38,000 new cases of chronic post-thoracotomy pain annually. This produces a profound emotional, medical and financial burden on these patients and their families. The high rate of chronic pain makes thoracotomy an ideal system to efficiently study predictors of chronic pain and to propose interventions that will eliminate or diminish this significant burden. Clearly, more research is needed to determine the causes of chronic post-thoracotomy pain and, hopefully, to decrease or eliminate it.

During recovery from thoracic surgery nearly 40% of patients suffer at least minor complications from retained secretions with atelectasis and shunting which can develop into pneumonia and disruption of the bronchial closure. A major component of this is pain inhibiting cough and cooperation with breathing exercises and pulmonary toilet.

For open thoracotomy, there have been no definitive studies to determine whether a classic posterolateral incision causes a different pain response from a vertical axillary muscle sparing approach. All current data point to no difference in outcome. Similarly, there are no differences in non-pain quality of life measures between the two incision types. Video assisted thoracic surgery (VATS) has had an unclear impact on pain. Randomized trials indicate no outcome difference in pain or other function measures, while multiple retrospective analyses where the assignment of VATS vs open thoracic surgery was not controlled typically strongly favor VATS. There are no high quality data to determine if robotic approaches alter pain outcomes.

Several recent reviews indicate that paravertebral blockade for perioperative analgesia is at least as effective as thoracic epidural blockade. Paravertebral catheters placed by surgeons at the end of thoracotomy are not as reliable as catheters placed by anesthesiologists. Typically only local anesthetic is infused for the paravertebral block whereas there is clear synergistic effect and dose sparing when local anesthetics and opioids are delivered through a thoracic epidural. These offer profound analgesia, but must be vigilantly monitored to ensure proper functioning so as not to endanger the patient either by epidural hematoma (exceedingly rare), hypotension (rare with paravertebral), or profound pain from non-function. Often supplemental NSAIDs and/or acetomenophen are routinely prescribed as pain with coughing can still be profound (5.5 out of 10) even when the epidural is functioning.


Norum HM, Breivik H. A systematic review of comparative studies indicates that paravertebral block is neither superior nor safer than epidural analgesia for pain after thoracotomy Scandinavian Journal of Pain Volume 1, Issue 1, Pages 12-23, January 2010
