Osteopathic manipulative treatment (OMT) is an important aspect of pain management and disease prevention. Advantages of OMT administered postoperatively include easy implementation and cost-effectiveness in terms of shortened hospital stays resulting from effective relief of acute pain. Patients who receive morphine preoperatively and OMT postoperatively tend to have less postoperative pain and require less intravenously administered morphine. In addition, OMT and relief of pain lead to decreased postoperative morbidity and mortality and increased patient satisfaction. Also, soft tissue manipulative techniques and thoracic pump techniques help to promote early ambulation and body movement.

(Key words: acute pain, chronic pain, osteopathic manipulative treatment [OMT], postoperative pain, soft tissue techniques, sympathetic nervous system, thoracic pump techniques)

Acute pain is associated with pathologic processes of tissue, emotional arousal, and focused sensory characteristics. This temporary, continually changing state induces certain immediate involuntary (reflex) and cerebral cortical reactions. Subsequently, these responses cause skeletal muscle contractions and intensification of glandular and vasomotor activity to produce changes in cardiovascular, ventilatory, and visceral functions, along with widespread endocrine responses. Cortical responses to acute pain include the emotional experience of pain itself, anxiety, fear, grimacing, screaming, and posturing such as splinting (ie, reduction of muscle movement in thoracic and abdominal regions). Although these responses to pain are beneficial in untreated disease, they serve no biological benefit in the postsurgical patient. Instead, postsurgical pain causing splinting, hypoventilation, and ileus may lead to atelectasis, pneumonia, nausea, vomiting, or stomach cramps that delay recovery and prolong the hospital stay. (Figure 1). In fact, improper treatment of this acute pain episode may lead to central nervous system remodeling, or facilitation, one of the most common causes of chronic pain.

Pathophysiology of pain

Afferent fibers closely associated with the sympathetic nervous system are known to be responsible for transmitting visceral pain. Peripheral nociceptive fibers may enter the central neuraxis by peripheral somatic or sympathetic nerves. On entry of these fibers, impulses generated by noxious stimuli undergo substantial neurochemical transformation and diverge to other levels, where they activate reflex sympathetic and...
somatic motor activity. These nociceptive impulses are then transmitted by ascending pathways to many levels of the brain, where further modulation and reflex activity occur.

The efferent pathway consists of myelinated preganglionic neurons, two paravertebral sympathetic chains, prevertebral and terminal ganglia, and unmyelinated postganglionic neurons. Preganglionic efferent fibers enter the paravertebral sympathetic chain and synapse at that same level or one in close proximity. Postsynaptic fibers leave the sympathetic chain by gray rami communicans and fuse with fibers of the somatic nerve root. Because afferent fibers of the peripheral sympathetic nervous system mainly arise within visceral structures, it is not surprising that they modulate feedback that modifies visceral, respiratory, and vascular reflex activity and transmit sensations of visceral pain and nausea. Painful pathologic processes within the thorax, abdomen, and pelvis cause activation of these afferent neurons, resulting in reflex increases in sympathetic activity. The increased sympathetic activity is associated with increased peripheral resistance, heart rate, and stroke volume; regional vasoconstriction; increased bladder and gut sphincter tone; and increased skeletal muscle tension.

Disruption of these afferent fibers, either at the paravertebral sympathetic chain or in prevertebral plexuses, produces relief of pain. Because the sympathetic nervous system is anatomically isolated from other components of the peripheral nervous system and is located in the paravertebral sympathetic and prevertebral sympathetic ganglia, an opportunity for osteopathic manipulative treatment (OMT) expands.

Clinical manifestation of pain
Surgery or trauma to the chest, abdominal, or pelvic regions most commonly produces respiratory dysfunction. Postoperative pain leads to splinting. The pattern of ventilation seen in these patients comprises a decreased tidal volume, high inspiratory and expiratory pressures, decreased vital capacity, decreased functional residual capacity, and decreased alveolar ventilation. This pattern leads to atelectasis and eventually lobular or lobar collapse. Concomitant with these possible respiratory complications will be a decrease in general lymphatic flow. As the diaphragm is an extremely important extrinsic pump, any change in its normal function will affect general myofascial tensioning throughout the body. Thus, localized visceral and peripheral flow of lymph (as well as venous return) can be compromised with dysfunction affecting the diaphragm. The importance of the diaphragm can be imagined by using the mean respiratory rate of 12 breaths per minute and expanding that to an average daily change in pressure gradients of 17,280 per day. Each one of these changes will have a direct effect on amplitude and rate of lymph flow.

Surgical trauma diminishes immunocompetence. This stress state in which corticotropin hormones are released induces granulocytosis and increased phagocytic activity. Chemotaxis, along with T and B lymphocyte and monocyte function, are diminished. These immunologic changes are also affected by the status of the lymphatic system and along with a negative nitrogen balance predispose the body to infection.

Recognizing that the sympathetic nervous system also controls the lumen diameter of lymph vessels, any increased sympathetic tone secondary to afferent nociception (eg, surgical incision, dissection) may cause altered lymphatic flow, tissue congestion, and resultant edema. Stasis in lymph flow can promote changes in pH, thereby initiating a proinflammatory environment in tissues. This change in environmental milieu may then lead to amplified fibroblastic infiltration, which subsequently can cause fibrosis, neurologic irritation, and attenuated arteriolar, venous, and lymphatic circulation.

Pain causing skeletal muscle hyper-
activity results in muscle spasm that leads to increased levels of nociception. Relief of muscle spasms, and therefore pain, has been achieved by massage techniques and spinal manipulation. Because the effects of manipulation are immediate, this treatment may increase the pain threshold and produce analgesia.

Osteopathic manipulative treatment intervention

The main innervation responsible for the hypersympathetic reflex associated with acute postoperative pain arises from thoracolumbar spinal segments. Corresponding sympathetic chain ganglia lie in fascia along heads of ribs in this region. Kuchera and Kuchera propose that rib raising will produce reflexes that clinically reduce this sympathetic activity. Doing this procedure at the levels of T5 to L2 should reduce sympathetic activity to the gastrointestinal tract. Herman made a clinical observation that rib raising at these levels decreases the incidence of postoperative ileus by 99.7%.

In addition to decreasing hyperactive sympathetic reflexes leading to ileus and abdominal distention, rib raising can be used to treat visceral-somatic reflexes. Those reflexes correlate with levels that innervate postoperative viscera producing thoracolumbar paraspinal musculature hypertonicity and patient discomfort can be normalized, thereby decreasing muscle tone and pain levels and easing patients’ efforts in taking deep breaths. The ability to take deep breaths is also dependent on diaphragmatic function. The lower six ribs particularly affect the diaphragm, and treating them with rib raising allows for excursion of the rib cage, improving venous and lymphatic drainage and decreasing the incidence of postoperative pneumonia.

Another important and sometimes overlooked aspect of osteopathic management of surgical patients is the preoperative musculoskeletal examination and OMT to any somatic dysfunction that is present. Presence of somatic dysfunction in a preoperative patient may be a factor complicating an otherwise normal outcome. As previously stated, facilitation is one cause of increased and chronic pain. A general sympathetica
	onia may exist and, in combination with nociception, the facilitated regions associated with somatic dysfunction can induce exaggerated autonomic responses in the neuroendocrine-immune system. As somatic dysfunction may cause nociceptive activity and the previously mentioned facilitation of any distal afferent impulses, it is important to normalize any regions that exhibit this condition. Otherwise, increased pain, decreased arteriolar circulation, and decreased venous and lymphatic return may result, leading to a less-than-optimal surgical outcome.

Further OMT of the thoracic inlet and other lymphatic structures will diminish lymphatic congestion, improving oxygenation and nutrition at the cellular level. This improved lymphatic response reduces the risk of infection, healing time, and fibrosis and scarring. Concerning pathology, “...usually, a relative lymphatic disturbance exists.”

- **Example of protocol for treatment of acute pain**—An example of a protocol for treatment of acute pain comprises the following sequence:
  - rib raising to normalize thoracolumbar region and thereby normalize sympathetic nervous system activity (this technique may be interchanged with treatment of the thoracic inlet);
  - treatment of the thoracic inlet,
  - treatment of the respiratory diaphragm, and
  - treatment of the pelvic diaphragm.

- **Example of protocol for treatment of subacute to chronic pain**—Treatment of postoperative patients with subacute to chronic pain after a normal inflammatory healing response at approximately 3 weeks should include the protocol for acute pain with the addition of myofascial directed techniques to the cimix. At this time, gentle direct or indirectly administered myofascial release techniques can be added. Proper diaphragmatic excursion with respiration should be maintained, and the patient should exhibit abdominal wall response from the lower ribs to the pubic symphysis.

  It is important to avoid techniques that incorporate unnecessary shaking or overhead arm techniques. The thoracic sympathetic pump techniques with arms overhead, or brisk pedal pump may jeopardize the integrity of the operative site of injury.

**Comment**

Studies have shown that effective relief of acute pain and the use of OMT lead to shortened hospital stay, decreased morbidity and mortality, and increased patient satisfaction. Present ongoing research has also showed a trend for less postoperative pain and less postoperative use of intravenous morphine associated with preoperative administration of morphine and postoperative OMT. The osteopathic approach has been historically positive for the patient in terms of early ambulation and body movement with the use of soft tissue techniques and the later-developed thoracic pump techniques. It continues to be an important aspect of pain and disease prevention, one that is easily implemented and cost-effective.

**References**


