



REGIONAL ANAESTHESIA IN THORACIC AND ABDOMINAL SURGERY

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SUMMARY – Surgical procedure causes tissue damage which activates systemic inflammatory response and leads to changes in endocrine and metabolic system. Anaesthesia and pain can further disrupt immune performance. Regional anaesthesia causes afferent nerve blockade and in this way mediates immune protection. Thoracic epidural analgesia is the cornerstone of pain relief in thoracic and abdominal surgery. Alternatively thoracic paravertebral block can be used with less side effects and good analgesic properties. Drugs that interfere with blood coagulation obstruct the use of central regional blocks. Surgery has also changed recently from open to minimally invasive. Also pain treatment for this procedures has changed to less aggressive, systemic or locoregional techniques. It was shown that transversus abdominis plane block and epidural analgesia have the same effect on postoperative pain, but transversus abdominis plane block was better regarding hemodynamic stability and hospital stay. Multimodal approach combining regional and systemic analgesia is currently the most appropriate perioperative pain management strategy. More studies should be done to give recommendations.

Key words: *regional anaesthesia, thoracic surgery, abdominal surgery*

Introduction

Surgical procedure causes tissue damage which activates systemic inflammatory response and leads to changes in endocrine and metabolic system (1).

The imbalance in immune system leads to organ damage and higher rate of postoperative complications (2). There are also other factors, like anaesthesia, pain, blood transfusions, and raised blood sugar that have important impact on the immune condition. Surgeon and anaesthesiologist can help with less aggressive surgical and anaesthetic techniques to maintain immune function (2,3).

It was shown that peak levels of serum cortisol were lower with regional anaesthesia compared to general anaesthesia (3). Regional anaesthesia causes afferent nerve blockade and as such modulates stress re-

sponse through decreased activation of the endocrine system (1). Combination of epidural and general anaesthesia was shown to be superior to general anaesthesia alone in terms of the duration of postoperative immunosuppression (4, 5).

Perioperative pain contributes to perioperative immune modulation by activation of the neuroendocrine axis. Appropriate pain treatment is one of the leading actions to reduce the damage of immune function (6).

In the following review, we briefly discuss the importance of effective pain control in modulation of perioperative stress response and the impact of regional anaesthesia in thoracic and abdominal surgical procedures.

Pain and immune response to surgical stress

Surgical injury causes somatic and visceral pain. It is one of the major contributors of surgery stress response, systemic inflammation and endocrine response. Nociceptive stimuli are transmitted through

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the pain pathways to the brain. Continuous communication between the central nervous system, endocrine and immune systems makes a positive feedback loop. Modulation of the pain perception with appropriate analgesia results in decreased levels of proinflammatory cytokines and raised lymphocyte activity (6, 7). On the other hand, prolonged or intense stimulation of these systems can be the cause of chronic or neuropathic pain (1). Immune response was reduced (decreased number of leucocytes, segmental neutrophils and lymphocytes) when clonidine was used as additive to epidural mixture lung surgery (8).

Thoracic and abdominal surgeries induce severe pain that contributes to perioperative morbidity and mortality (9). Appropriate pain treatment before, during and after the surgery is still the mainstay of the chronic pain prophylaxis. The emphasis is on the regional techniques, however (10, 11).

Regional anaesthesia in thoracic surgery

Postoperative pain and respiratory failure are one of the main complications after thoracic surgery. Impairment of respiratory function can be prevented with adequate pain treatment. Local and visceral pain are caused by surgical injury to skin, intercostal muscles, ribs, costovertebral joints, intercostal nerves and deeper tissues. Nociceptive transmission proceeds through C and A delta fibres in three ways: intercostal nerves transmit stimuli from skin, ribs, joints and muscles, vagal nerve carries stimuli from lung and mediastinum, and phrenic and intercostal nerves innervate pleura (12). Although pain management strategies for thoracotomy are known, there are no widespread surgical or anaesthetic recommendations (13, 14). Thoracic epidural analgesia (TEA) is the cornerstone of postoperative analgesic protocol in thoracic surgery. Thoracic paravertebral block (TPB) is appropriate analgesic technique for patients with more risk factors (14, 15). It was shown that hypotensive events, urinary retention and postoperative nausea and vomiting (PONV) are less frequent with TPB than with TEA (16, 17). The application of analgesic mixtures through the paravertebral catheter as compared to standard epidural was equal regarding the effect on the development of post-thoracotomy syndrome, chronic pain after the procedure as well as the quality of life (18). TPB was shown to cause fewer side effects, longer duration

of analgesia and better quality of life in comparison to intercostal and interpleural regional techniques (19). Novak-Jankovic with co-workers showed that thoracic paravertebral analgesia with levobupivacaine results in better pain scores and needs less rescue and opioid analgesics than analgesia with bupivacaine (20). Epidural analgesia in patients undergoing major spine surgery showed better postoperative analgesic profile with lower opioid consumption and lower incidence of side effects (21).

Epidural anaesthesia and analgesia

Epidural analgesia is defined as the intraoperative epidural application of local anaesthetics (LA), opioids and other drugs with analgesic properties. It provides excellent pain control without motor blockade and sedation in comparison to spinal and systemic analgesia (12, 22). Epidural analgesia is associated with a zone of differential block. Its effect is not only analgesia, but also the impact on cardiovascular, coagulation, pulmonary function, gastrointestinal system and the modulation of stress response (9, 12).

Validation of risk factors and benefits of epidural placement should be made before the procedure. Major risks are local anaesthetic (LA) toxicity syndrome (LAST), allergy, dural puncture, epidural hematoma and nerve root injury (9, 13).

Major contraindications for epidural analgesia are: patient refusal, local or systemic infection, sepsis and coagulation disorders. Other contraindications, like neurologic deficit, respiratory failure, severe cardiac disease, increased intracranial pressure and lack of cooperation are relative (9).

Paravertebral block

Paravertebral blocks (PVB) produce unilateral trunk anaesthesia by blocking the segmental nerves of the spinal cord. The paravertebral space contains spinal nerves (the dorsal and ventral branches of the spinal roots) and sympathetic chain (Figure 1). Thus application of anaesthetics into this space results in one-sided motor, sensory and sympathetic block.

PVB are performed on the side of the surgical procedure with single injection or catheter placement (22, 23). TPB are performed in thoracic spine region and result in unilateral nerve blockade in thoracic dermatomes above and below the site of blockade (19). Breast surgery and lung surgery are the main indica-

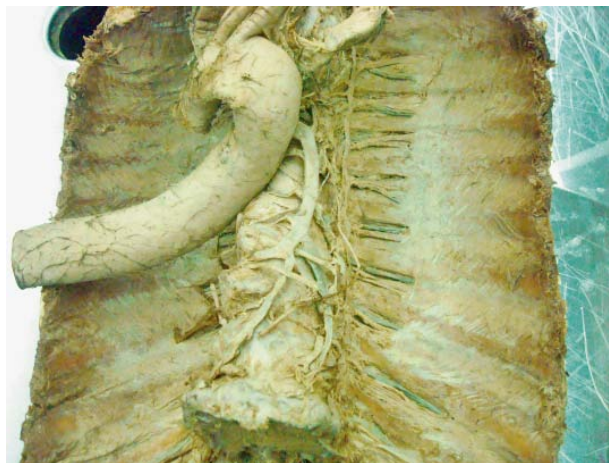


Figure 1. Sympathetic chain and spinal nerves in the paravertebral space

tions for TPB. It was reported to be useful in providing analgesia for minimal invasive cardiac surgery (23). There is supporting evidence for TPB performance before cholecystectomy, nephrectomy and hepatectomy because it provides visceral analgesia (24).

Other possible indications for PVB are the treatment of hyperhydrosis, angina pectoris and different chronic pain syndromes, cancer pain and post herpetic neuralgia (23). The absolute and relative contraindications are the same as for epidural block (9).

Intercostal nerve block

Intercostal nerve block (ICNB) interrupts the flow of afferent pain signals through intercostal nerve. It is used for pain relief in breast, thoracic and upper abdominal surgery, after rib fractures and in different problems affecting chest and abdominal wall. It is indicated in higher risk patients who have contraindications for TEA and TPB (13, 22). The main side effect is pneumothorax with occurrence rate around 1%. Ultrasound guidance improves the method safety. During surgery the block is usually performed by the surgeon before the chest closure. It does not block visceral pain. Other pain treatment modalities should be added to ensure adequate pain control after thoracotomy (22).

Intrapleural analgesia

It is the method for postoperative analgesia based on injection of a LA into the pleural space and results

in retrograde blockade of intercostal nerves (25). It is not efficient enough for a surgical procedure and has to be combined with other analgesic techniques (22).

Phrenic nerve infiltration

Shoulder pain on the side of the procedure is often reported after thoracic surgery. The irritation of the diaphragm is transmitted along the phrenic nerve and is not covered with TEA or PVB. Phrenic nerve block with lidocaine significantly alleviated shoulder pain in comparison to placebo (26).

Regional anaesthesia in abdominal surgery

Use of epidural analgesia for major abdominal surgery has decreased recently. The increasing frequency of anticoagulation drugs prescriptions are one of the main reasons. They have unpredictable effect on blood coagulation and endanger the safety of neuraxial techniques. Abdominal surgery has also changed from open to minimally invasive procedures. The postoperative pain treatment protocols had to become more flexible and some local and regional techniques were introduced to anaesthesia. One of the most important was the transversus abdominis plane block (TAP) (27, 28). TAP blocks were reported to reduce PONV, postoperative ileus and paraesthesia more than TEA in laparoscopic colon surgery (29). Spinal anaesthesia is indicated only for anal surgery where severe postoperative pain is expected or local infection make the local technique impossible (11).

Epidural and caudal block

Epidural and caudal analgesia were the mainstay in abdominal surgery for adults and children. Their most important adverse events are caused with sympathetic blockade and increased intracranial pressure. The impact of analgesia on bowel function is one of the main concerns in abdominal surgery. Systematic review has shown, with high level of evidence, that epidural analgesia stimulates recovery of gastrointestinal function after the surgery. Its impact on pain relief, PONV and hospital stay was less pronounced in comparison to opioid based analgesia (28). TAP block was shown to reduce the length of hospital stay and the frequency of hypotensive events in a systematic review and meta-analysis (27, 28).

Thoracic paravertebral block

TPB was reported to improve pain relief and to reduce opioid consumption in comparison to systemic analgesia in adult patients after abdominal surgery. No differences were shown in comparison to epidural or other analgesic techniques (24).

TPB interrupts somatic and visceral pain signals, and as such is better than TAP block (29). Recent studies report that TBP provides better analgesic profile in comparison to TAP block and ilioinguinal or iliohypogastric block. More studies should be done to give recommendations (30, 31).

It is proposed that quadratus lumborum block causes PVB by spreading of LA to paravertebral space. No evidence has been made yet to show its advantage over direct PVB (32).

TAP block

This block provides analgesia of the anterolateral abdominal wall by blocking the intercostal nerves (T7–T11), the subcostal nerve (T12), the ilioinguinal and iliohypogastric nerve (L1–L2) (29). Initially LA was injected between internal oblique and transverse abdominal muscle using landmark technique (33). Nowadays, several different ultrasound-guided approaches are used (lateral, posterior, subcostal). In the past decade, many studies supported the effectiveness of TAP blocks for caesarean section, hysterectomy, cholecystectomy, colectomy, prostatectomy, and hernia repair (34). Although its analgesic effect covers only somatic pain with short duration, single-shot TAP block plays a valuable role in multimodal analgesia (33,34).

Conclusion

Surgery techniques are improving and becoming less invasive. Analgesia regimens should be adjusted and pain should be treated adequately. The modern analgesic strategy is based on multimodal approaches with involvement of less aggressive regional techniques that modulate the surgical stress response and help to reduce the risk for chronic pain. Neuraxial techniques provide both visceral and somatic analgesia and are needed for special patients and surgical procedures.

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Sažetak

REGIONALNA ANESTEZIJA U TORAKALNOJ I ABDOMINALNOJ KIRURGIJI

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Kirurški zahvat uzrokuje tkivno oštećenje koje aktivira sistemski upalni odgovor i dovodi do promijena u endokrinom i metaboličkom sustavu pacijenta. Anestezija i bolovi mogu još dodatno utjecati na imunološki sustav. Regionalna anestezija uzrokuje aferentnu blokadu živaca i time dovodi do zaštite imunološkoga sustava. Torakalna epiduralna analgezija je zlatni standard za liječenje bolova u torakoabdominalnoj kirurgiji. Alternativna tehnika je torakalni paravertebralni blok koji ima manje nuspojave i dobar analgetski učinak. Antikoagulantni lijekovi ograničavaju upotrebu centralnih živčanih blokova. Kirurške se tehnike mijenjaju u smjeru minimalno invazivnih kirurških tehnika. Isto tako tehnike liječenja bolova se mijenjaju prema upotrebi manje agresivnih sistemskih i lokoregionalnih tehnika. Studije su pokazale da su "transversus abdominis block" (TAP) i epiduralna analgezija jednako učinkoviti u liječenju postoperativnih bolova, s tim da se kod TAP blokova puno rjeđe pojavljuje pad krvnoga tlaka i da je vrijeme hospitalizacije kraće. Multimodalni pristup s kombinacijom regionalne i sistemske analgezije je trenutno najbolja tehnika za liječenje perioperativnih bolova. Potrebna su dodatna istraživanja da bi se izradile smjernice.

Ključne riječi: *regionalna anestezija, torakalna kirurgija, abdominalna kirurgija*