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Pain management in trauma patients

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Effective pain management in trauma patients requires an understanding of both the physiologic responses to injury, and the potential modification of the responses produced by analgesia; as well as knowledge about benefits, limitations, and adverse effects of analgesic methods. Complex, multisystem injuries occur frequently and therapeutic intervention for the control of pain must be carefully incorporated within the overall management plan. Various methods of pain management, and strategies for patients with specific injuries are discussed.

Key words : *Pain management, Analgesia, Trauma, Posttraumatic.*

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Objective

- To update the knowledge for the strategies of pain management in traumatized patients.

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การบำบัดความปวดอย่างมีประสิทธิภาพสำหรับผู้ป่วยที่ได้รับบาดเจ็บ จำเป็นต้องมีความรู้และความเข้าใจพยาธิวิทยาของร่างกายต่อการบาดเจ็บและผลของการระงับปวดทั้งในด้านของประโยชน์ ข้อจำกัด และผลแทรกซ้อนของวิธีระงับปวด การบาดเจ็บของอวัยวะหลาย ๆ ระบบ มักพบได้บ่อย ซึ่งการบำบัดความปวดในผู้ป่วยกลุ่มนี้ต้องสอดคล้องอยู่ภายในแผนการรักษาของผู้ป่วยตั้งแต่เริ่มแรก ทั้งในแง่ของการใช้ยาแก้ปวด และการระงับปวดเฉพาะที่ของร่างกาย

Trauma is a leading cause of death in Thailand.[1] Management of traumatic patients requires a multidisciplinary team.[2-4] Pain and the associated stress responses observed in trauma patients should always be viewed as detrimental, and attempts at alleviating the pain deserve high priority whereas the entire clinical condition needs to be assessed, and optimal management is provided.

Pathophysiology

Pain sensation and stress responses belong to a natural protective mechanism of the body. The stress responses after trauma are characterized by increased catecholamine and cortisol levels, which can be essential to the maintenance of homeostasis in the absence of appropriate intervention. The stress response may help promote survival. It is triggered by a variety of factors associated with injury, including the release of humoral substances from the injured tissues, hemorrhage, pain, fear, hypoxia, hypercarbia, acidosis, and changes in body temperature. These factors raise sympathetic efferent activity, along with elevated serum levels of stress hormones. The observable manifested results are, for example : tachycardia, hypertension, decreased renal and splanchnic blood flow, decreased glomerular filtration, salt and water retention, and hyperglycemia.[5] Once the process of injury has been identified, and diagnostic delineation of the injury is complete, further nociceptive information serves no protective role. Pain is considered to be an important factor in the production of the stress response. Thus, suppression of the responses though alleviation of pain should be considered beneficial rather than deleterious, as long as the pain treatment modalities do not cause uncontrollable hemodynamic alteration and adrenocortical hormone depletion.[2] Reduction of stress, restoration of function, and prevention of subsequent complications are all intimately related to posttraumatic analgesia and must be addressed.[5]

Besides the deleterious effects of the stress response, pain can also impair the organ function through other mechanisms. For example, trauma - related pain that caused by thoracic and upper abdominal injury, decreases pulmonary function via chest splinting and reflex-activated diaphragmatic dysfunction. The consequent hypoventilation and atelectasis results in ventilation/perfusion mismatching and hypoxemia. Functional residual capacity, cough, and vital capacity are all decreased with the consequent retention of secretions, progressive atelectasis, and development of secondary pneumonia. Increased sympathetic tone from pain may decrease gastrointestinal motility producing an ileus which complicates the delivery of nutritional support.[6] Some of the neuropeptides released from the nociceptors can bring about intense vasodilatation, increased vascular permeability, which can further compromise hemodynamic parameters. Generally, cardiac output and stroke volume are reduced in proportion to blood loss, but the presence of peripheral nerve stimulation or tissue injury substantially exacerbate the reductions.[7] A study by Rady et al, demonstrated that, the induction of traumatic shock after a moderate blood loss is exacerbated by tissue injury and peripheral stimulation of somatic nerve. The mechanism for such interactions may include deterioration in left ventricular mechanical performance and an increase in systemic critical O_2 delivery and, to a lesser degree, an enhanced loss of plasma from the intravascular

space. Adequate cardiac function and systemic oxygenation may be promoted by optimum pain relief, attenuation of sensory input from the injured extremities, and debridement of devitalized and crushed tissue during the early phase of resuscitation of polytrauma patients.[7]

Current status of posttraumatic pain management

Interestingly, a number of studies revealed that posttraumatic pain relief was usually inadequate. According to White et al, administration of analgesics to pre-hospital patients with suspected fracture was only 1.8 %.[8] Also, Baskett noted that pre-hospital analgesia was inadequate.[9] DeVellis reported that some patients who received fentanyl during their transportation to the hospital, received no analgesia in the emergency room; those who received such analgesia often had administration delays surpassing the clinical half-life of intratransport administered fentanyl.[10] Further, Jantos et al reported inadequate administration of analgesia for patients in the emergency room.[11] Morgan-Jones, studied in patients with skeletal injury, and found that as many as 23 % of acutely injured patients received no analgesia preoperatively.[12] Another prospective study by the same authors showed that, preoperatively, 54 % of trauma patients described their pain as 'severe' or 'the worst possible pain', and 36 % would have liked more analgesia.[13] According to Whipple et al, 74 % of patients with multiple injuries in ICU reported poor analgesia, and rated their pain intensity as moderate to severe.[6,14] According to Carroll et al, in a multicenter study, 64 % of critically ill posto-perative and trauma patients suffered from moderate to severe pain while they were in ICU.[15] Children have more chance than adults to receive inadequate analgesia. Selbst and Clark reported a retrospective study that 60 % of adults but only 28 % of children, who were presented to an emergency room with long-bone fracture, received adequate analgesia.[16] Petrack et al documented a rate of analgesia used for long-bone fracture in emergency room of 53 % in children and 73 % in adults.[17] Friedland et al, found that analgesic used in the emergency room was low in mildly to moderately injured children with presumably painful fractures who were also at risk for associated multiple injuries; and head injury was associated with markedly low analgesic use. [18] Roberts et al found that the amount of analgesic drugs, given to patients with fractures of femoral neck while awaiting surgery, seemed inadequate for their levels of perceived pain.[19]

Goals in posttraumatic pain management

An important goal in posttraumatic pain management is early restoration of organ function. Cellular function depends on blood flow for delivery of nutrients to the tissues. Sympathetic blockade can be used to decrease vascular resistance and to improve skin and vascular graft flow, while decreasing pain-mediated vasoconstriction. A second goal in the management of post-traumatic pain is the modulation of both early and delayed sequelae following injury. Myofascial pain syndromes resulted from injury to musculoskeletal structures and disuse secondary to pain and muscle spasm are minimized with early ambulation and mobilization of injured extremities. The development of late posttraumatic pain syndromes may also partially depend upon initial pain manage-ment.[20] The cost of long-term pain management of

both treatment and disability far outweigh the short-term cost of acute pain management in trauma care.

When dealing with the trauma patients, attention is at once directed toward initial resuscitation and stabilization. Priority is given to establishing ventilation and cardiovascular stability, controls of external hemorrhage, and restoration of fluid and blood volume.[21] All trauma patients should be considered as having an unstable cervical spine and a full stomach, hypovolemic;and if the person is unconscious or confused, he/she should be assumed to have a closed head injury.[22] Obviously, analgesic therapy of a severely traumatized patient is not a priority until the primary resuscitative measures have been carried out. Analgesia should not be delayed, once the initial assessment and stabilization are complete. Analgesia should be regarded as parts of the resuscitation process for it brings not only compassionate relief but also cardiovascular stability, that subsequently improves organ and tissue perfusion.[5]

Methods of pain management

1. General principles

Injured patients always need analgesia both to provide comfort and minimize end-organ damage. Also, they often need pain relief to tolerate routine diagnostic tests, such as x-ray or CT scan. Occasionally, analgesia is a standard of treatment, such as in the reduction of a dislocated shoulder. The choice of analgesic and the route of administration must be carefully selected with consideration of the prevailing cardiovascular, respiratory, and neurological circumstances, as well as the possibility of aspiration of gastric contents.[5]

Cardiovascular system : Reduced cardiac output and plasma volume may considerably alter the pharmacokinetics of the administered drugs. Normal doses of drugs given at conventional rates may produce extremely high plasma levels. Muscle blood flow may be seriously impaired, thus preventing the uptake of drugs administered by the route. Organ perfusion may also be altered, which can affect the clearance and elimination of analgesics. Berkenstadt et al, as well as Christie et al, demonstrated that morphine clearance and volume of distribution was reduced, and half-life was increased.[23,24] Furthermore some of the systemic or regional analgesic techniques cause decreased in sympathetic tone, and can cause hemodynamic instability in hypovolemic posttraumatic patients.

Respiratory system : The pain therapy that may interfere with the mechanics of respiration (chest muscle function, airway patency, etc) or central control should be used with cautions. A rise in $PaCO_2$ caused by hypoventilation will cause cerebral vasodilatation; this is critical importance in cases where the intracranial pressure is already elevated.

CNS : If there is any doubt about the patient's level of consciousness, this has to be evaluated first before the application of sedatives of analgesics. In patients suspected to have intracranial pathology, drugs either masking or imitating the signs of raised ICP - sedation, vomiting, or pupillary dysfunction - should be avoided. Epidural anesthesia, which carries the risk of dural puncture, may result in brain herniation. Deposition of local anesthetic agents into the epidural space can cause a considerable increase in intracranial pressure.

Gastrointestinal system : The stomach may be full, and gastric emptying may be delayed. The splanchnic blood flow may be reduced. Generally, but mild acute

trauma patients, drugs should not be given by the oral route. Narcotic can cause vomiting and delay gastric emptying even further.

Other principles of management : Trauma patients may have pain in more than one site. Thus, an appropriate pain treatment modality should be selected to provide analgesia with the least amount of drug and as the fewest steps of procedure as possibles. The patient may be intoxicated or under the influence of other drugs, which may interact with analgesic medications. It should be emphasized that, both systemic and particularly regional analgesia may potentially obscure physical signs of serious underlying injuries, such as neurovascular injury, compartment syndrome, or visceral organ injury. Pond et al, reported an excellent pain relief with interpleural lidocaine in a patient with multiple rib fractures after a motor vehicle accident. The pain of delayed traumatic splenic rupture was masked until discontinuation of such analgesia.[25] If analgesic methods are to be employed that put the patient at risk for a diminished response of developing signs of injury, serious consideration should be given to first reliably to exclude injuries with all available diagnostic methods.

Besides the patients' condition, the choice of analgesia also depends on the ability of the attending physician. In general, but especially in emergencies, no anesthetic or analgesic agent should be used unless the clinician understands the proper technique of administration, dosage, contraindications, side effects, and treatment of overdose.

2. Techniques for pain management

2.1 Systemic medications

Stress response inhibition requires higher doses of narcotics than those required to control pain. Systemically administered opiates in their usual doses may provide partial pain relief, but they cannot adequately block endocrine and metabolic responses.[5]

Oral medications : Oral analgesic should be avoided during the immediate post-injury period. There is a possibility of vomiting and aspiration as well as decreased gastrointestinal activity with lack of predictable absorption. The route is very useful in the postoperative period after the gastrointestinal system is functioning adequately. Oral opioid analgesics can be used in patients who continue to suffer moderate to severe pain, and as supplements to patients treated with regional analgesia. Sustained-release oral opioid offers less frequent administration intervals. The agents are suitable for patients who suffer from a discomfort during rehabilitation or chronic pain. Oral NSAIDs are also beneficial as a supplement of opioids or regional analgesia in the patients who are already stabilized and the risk of gastrointestinal hemorrhage is reduced.[26]

Intramuscular or subcutaneous medications: Intramuscular or subcutaneous injections of analgesics are not suitable during the immediate post-injury period. The impaired peripheral tissue perfusion leads to erratic absorption from the injection site, results in delayed onset, and inadequate analgesia. When adequate perfusion resumes, the previously non-absorbed drug is released and can cause dangerously high plasma drug level.

Intravenous medications: Intravenous analgesic boluses can eliminate absorption variability associated with intramuscular or subcutaneous routes. In the pre-hospital setting, ketamine 0.2-0.5 mg/kg body weight

is one of the good choices. Tachycardia and hypertension are not significant at this low dose. Repeated dose can increase the blood pressure, which is good for the shock patients. Its short duration of action enables pain to resume while the patients arrive at the hospital, so the diagnoses of organ injuries are not masked.[27] In head injured patients, the drug should be given with caution, since it can increase intracranial pressure.

Intravenous opioids can alleviate posttraumatic pain. All the opioids reduce sympathetic tone, small incremental doses, guided by the clinical response, will reduce the danger of circulatory collapse. Morphine can be given initially in a small dose, such as 0.05 mg/kg, supplemented with 50 -100 % of the initial dose, according to the patient response after 5 -10 minutes. Pethidine is the most powerful cardiovascular depressant and should be used with great caution in the hypovolemic trauma patients. Fentanyl, 0.5-1ug/kg, followed by 1-1.5 ug/kg/hr infusion, may be preferable when cardiovascular stability is problematic, given that patients are closely monitored and/or intubated.[5] Tramadol may be a safe analgesic in the pre-hospital setting. Vergnion et al compared 100 mg of tramadol and 5 -10 mg of morphine, dosages of which could be doubled if needed, in pre-hospital trauma patients, and found no difference in analgesia as well as sedation scores, nor physiologic difference between the groups. They concluded that tramadol is an acceptable alternative to morphine in pre-hospital trauma settings.[28] Chambers et al, found that nalbuphine can be safely administered by trained paramedics to provide effective analgesia to the patients in pain in a pre-hospital setting.[29]

Regular assessment of vital signs and level of consciousness is necessary when parenteral opioids are used for managing acute traumatic pain. Because of wide inter- and intra-individual variations in response to opioids, an occasional patient will have an adverse reaction despite even the most careful titration of doses and intervals.

Benzodiazepines are useful to supplement opioid analgesics for painful procedures such as during orthopedics reduction. Particular vigilance and monitoring are necessary since giving the two drugs concomitantly increases the risk of respiratory depression.

The repeated doses of intermittent injection of opioid analgesics is labor-intensive. The second problem of 'prn' basis is inability to maintain therapeutic plasma concentration. Continuous intravenous infusions are less labor-intensive and overcome other shortcomings observed with intermittent intramuscular or intravascular dosing regimens. They provide effective pain control and a level of sedation that facilitates mechanical ventilation. Drawbacks associated with continuous opioid infusions include tolerance development requiring an increased infusion rate, and a progressive increase in plasma levels of drug, which may lead to excessive sedation and respiratory depression. Additionally, this method requires personnel who comprehend about how to use the infusion device, as well as to detect and rectify a malfunction, should it occurs.

Intravenous patient-controlled analgesia : Such therapy avoids cycles of excessive sedation and ineffective pain control observed with either on-demand or by the clock intermittent dosing, and limits variabilities related to inappropriate screening, delays

in administration, and drug absorption.[25] The disadvantage is that special, sophisticated equipment as well as personnel who can use it are required.

2.2 Regional analgesic techniques

In the posttraumatic patients, regional analgesic techniques can provide excellent pain relief, improvement of respiratory function, reduction of sympathetic tone, and improvement of organ blood flow. It should also be considered that many of the regional analgesic method using local anesthetic agents may cause hypotension in the hypovolemic patients. Additionally, sufficient time may not be available to perform the block in patients with unstable presentation. Also, the nature of injuries may not permit adequate positioning for catheter placement. However, these techniques are of benefit in appropriately selected patients particularly in patients with thoracic and/or extremity injuries.

Pain management in some specific groups of patients

1. Patients with thoracic injuries

In patients with thoracic trauma, early respiratory failure (less than 24 hours after injury) are generally caused by primary insults (such as contusions) to the chest wall and lungs, and pre-existing diseases. Later respiratory failure (more than 24 hours) may occur with the progressive atelectasis and secretion retention that occurs secondary to an inability to cough or the suboptimal administration of effective chest physiotherapy and pulmonary toilet.[6] The patients with significant lung parenchymal injuries should be intubated and mechanical ventilated. In the patients without significant injury to the lung, if the pain is kept under adequate control, allowing them to breathe deeply and to cough effectively to mobilize and clear secretions, intubation may be avoided.[2,30]

In this group of patients, conventional doses of systemically administered narcotic are usually ineffective. Increasing the dose until pain relief is obtained may results in cough suppression, excessive sedation and respiratory depression. Various regional analgesic techniques can provide excellent analgesia, improved ventilatory mechanics, reduced stress response to injury, reduced risk of pneumonia, and many other benefits.[31,32] Again, it should be remembered that, although pain relief by regional analgesia can help the patient to clear the respiratory secretions, such analgesia is not able to restore a vital capacity diminished by lung contusion. Hypoxemia and the increased work of breathing secondary to chest wall trauma and severe pulmonary contusion are the main factors limiting an effective conservative approach to the management of patients with isolated chest trauma.[33]

1.1 Strategy of management of regional analgesia after thoracic trauma[34]

- For the patient with severe associated injuries, mechanical ventilation, internal pneumatic stabilization, and intravenous analgesia, are the treatments of choice. Since it can often be difficult initially to predict the length of time a patient will require mechanical ventilation, regional analgesic techniques may not seem so appropriate in this early period. Once a weaning from mechanical ventilation is planned, the regional analgesia can be used to facilitate the successfulness of the weaning.

- If the thoracic trauma is isolated, the main issue is to avoid tracheal intubation if possible (but that should not be interpreted to mean postponing a

mandatory tracheal intubation and mechanical ventilation, if indicated).

- For the patient with severe pre-existing physical illness, like chronic respiratory insufficiency, old age, or other risk factors, the best choice seems to be a regional analgesia. In the same way, when there are extensive thoracic parietal defects, epidural analgesia represents the method of choice, and lumbar epidural morphine seems to be the easiest to use in emergency. However, in this case, close monitoring in the ICU is mandatory, especially as the patient may quickly develop complications.

- Conversely, thoracic trauma occurring in an ASA I patient may benefit from different management. So, in the case of unilateral injuries, intercostal nerve block, or interpleural analgesia may be performed, and will be further facilitated if a chest tube is required. Epidural analgesia also can be used. On the other hand, in case of bilateral injuries, one may select intravenous analgesia, either classical or using patient-controlled analgesia.

1.2 Epidural analgesia

Several studies demonstrated the benefit of epidural analgesia either with local anesthetics and/ or narcotics, over systemic analgesics, in improving the outcome in patients with thoracic trauma.[6,35-43]

If the technique is to be used, be cautious to correct hypovolemia the patients may have, and to carefully titrate the dose of local anesthetics guided by clinical response, otherwise hemodynamic instability or even collapse may develop due to sympathectomy caused by epidural local anesthetic agents.[5] Hypotension caused by epidural analgesia may be deleterious to patients with head injuries. The decreased cerebral perfusion caused by hypotension may lead to serious cerebral hypoxia. In addition, injection of local anesthetics into the epidural space can produce a transient but clinically significant increase in intracranial pressure, and incidental dural tap may be potentially fatal.

1.3 Intrathecal morphine [34]

Intrathecal bolus doses of morphine provide prolonged analgesia in settings where epidural catheter is contraindicated or technically difficult to place, and the patient is expected to remain intubated for 24 hours. A major disadvantage of intrathecal morphine is the limited duration of analgesia.

1.4 Intercostal nerve block

Intercostal nerves can be blocked with local anesthetic agents. The block is associated with higher blood concentrations of local anesthetics than that used in most other types of nerve block, so there is a risk of local anesthetic toxicity. The duration of action of such block lasts not more than 12-16 hours, approximately, and the procedure has to be repeated. Repetitive injections increase the risk of iatrogenic pneumothorax and are painful for patients; it is also awkward for the patient as well as the hospital personnel.[34] Shanti et al, found that the incidence of pneumothorax was 1.4 % per each intercostal nerve blocked, and 6 % per an intercostal nerve block procedure.[44]

However, a catheter can be inserted for intermittent injection or continuous infusion of local anesthetics, without the need of repetitive puncture. This can be performed by introducing a Touhy needle at the angle of the rib, then it is walked down under the lower border of the rib and advanced for 3 mm. With the bevel of the needle pointed medially, a catheter is advanced 3-4 cm into the intercostal

space. Continuous infusion of local anesthetics offers effective pain relief. The innermost intercostals muscle layer is thin, non-continuous, and thus permeable to local anesthetics to spread to 3-5 adjacent intercostal nerves, providing multisegmental blockade.[26] This technique may be performed in patients with multiple rib fractures and concomitant head injuries, who are contraindicated for systemic opioids or thoracic epidural analgesia.[26] It should be kept in mind that the catheter tip can sometimes be in the interpleural space, and thoracic sympathetic blockade with subsequent unilateral Horner's syndrome can occur, which can confuse the clinical monitoring for intracranial mass lesion requiring surgical intervention.[45]

1.5 Interpleural analgesia

Interpleural analgesia can be performed by injecting the local anesthetic agents into the pleural cavity, using either an epidural catheter or a chest tube. It can also provide effective analgesia in selected patients with unilateral multiple rib fractures.[46-48] To relief pain of the upper thorax, the catheter should be inserted toward the apex of the lung in supine patients, since the distribution of local anesthetics tended to be gravity dependent.[47,49]

This type of analgesia can cause a high serum levels of local anesthetics,[50] and with adrenaline added (1:200000), the level can be dramatically reduced.[51] Pneumothorax can occur in 2 % of cases.[50,52] Horner's syndrome can also occur.[34,50]

1.6 Paravertebral block

Injection of local anesthetics into the paravertebral thoracic space, which contains the proximal portions of the intercostal nerves and the rami communicantes of the sympathetic nervous system, can provide unilateral somatic analgesia with some degree of sympathetic blockade. However, its complications include pneumothorax, and epidural or intrathecal injection with risk of severe hypotension and respiratory insufficiency.[53-54]

2. Patients with intra-abdominal injuries[5,32]

Injuries to the abdominal cavity often require surgical exploration and repair. Pre-operative abdominal injured patients, and the patients who have undergone abdominal exploration, have significant decrease in respiratory parameters, as in patients with thoracic injuries. Such patients can also benefit from adequate pain management. The principles of pain management in this group of patients are not much different from those of the patients with thoracic injuries. Intravenous opioids, either intermittent dosing, continuous infusion, or patient-controlled analgesia can be used. Continuous, low - or mid-thoracic epidural analgesia is also more beneficial than systemic medications, particularly in high-risk patients.

3. Patients with head injuries

Systemic opioids can cause respiratory depression with subsequent increase of $PaCO_2$ and intracranial pressure, so they are best to be avoided, unless the breathing is controlled. Additionally it may cause pupillary constriction, which may confuse the value of eye signs. Many of regional analgesic techniques can also cause confusion of the eye signs, ie, Horner's syndrome can complicate interscalene brachial plexus block, intercostal block, and interpleural block.[45,52]

Already mentioned, epidural block also posses risk in head injured patients.

In patients who are intubated with mechanically controlled respiration, systemic analgesics may be given without the risk of hypoventilation. In patients who are not intubated, however, regional analgesic techniques may be used to provide analgesia for concomitant injury, with the considerations mentioned above. Analgesic choices may be easier to select if the decisions regarding further therapeutic measures, including operations, are made using computerized tomography, but not clinical neurologic examinations.

4. Patients with extremity injuries

In patients with extremity injury, there are a number of techniques, other than systemic opioid analgesics, that provide adequate pain relief and facilitate further treatment such as closed reduction or surgical interventions.

For the upper limb trauma, brachial plexus block can be performed.[32] The choice of technique depends upon the site of the injury, the patient's ability to abduct the arm, and the presence of head injury requiring observation. Analgesia for higher lesions (upper arm injury, dislocated shoulder, etc) is best achieved with interscalene block. When there is associated head injury that do not require immediate neurosurgical intervention, the axillary approach may be preferable to the interscalene technique, to avoid Horner's syndrome that can occur with the latter technique.[5]

Femoral nerve block provides an excellent pain relief for the midshaft femoral fracture, a good relief for the lower third, and partial relief for upper third.[32] It is easy a process to perform and can be used even in the pre-hospital settings. Femoral nerve block can be extended to give continuous analgesia by insertion of a catheter. By increasing the volume of injectate and encouraging its cephalad spread, femoral nerve block can be extended to include the lateral femoral cutaneous and the obturator nerves.

Epidural block can alleviate pain of trauma of lower extremities. In patients with vascular disruptions, amputations, and peripheral crush injuries, who are in need of surgical intervention, epidural block can also diminish sympathetic overactivity that occurs reflextively with such injuries, and which may linger even after vascular re-anastomosis. Thus, the block can improve extremity blood flow and surgical outcome.[2] One group that can particularly benefit from epidural analgesia are patients with traumatic amputation who need daily dressing changes of revisions of their stump.

In patient whose assessment of limb motor function and of pain is important for diagnostic purpose, regional analgesia should be used with cautions; and long acting anesthetic agents should be avoided.[5,55] If epidural analgesia is to be used, epidural opioids seems to be more appropriate than epidural local anesthetic agents.

Intravenous regional anesthesia is a simple way to provide analgesia to the injured extremity. The extremity is elevated, applied with Esmarch bandage to remove the blood; then the tourniquet is applied proximally and the local anesthetic is injected intravenously distally.[32,56] Advantages are that the technique is simple to perform, onset is rapid, and anesthesia and muscle relaxation distal to the tourniquet is obtained for surgery. Disadvantages include possible toxic effects of local anesthetics upon release of the tourniquet or if the tourniquet fails, no postoperative analgesia, and the possibility of

increased swelling.[57]

Subcutaneous infiltration of local anesthetic can be used for analgesia of minor wounds. Local anesthetic sterilely injected into a fracture hematoma for a reduction of closed fracture, e.g. 5 -10 ml of 1% lidocaine for reduction of Colles fracture, can be used in situations where staff or resources are limited.[25]

Gurnani et al demonstrated that, in patients with acute musculo-skeletal trauma, those who received subcutaneous ketamine infusion (0.1 mg/kg/hr) had better pain relief, better consciousness, with less incidence of nausea and vomiting than those who were given intermittent intravenous morphine (0.1 mg/kg, four-hourly).[58] However, one should consider that peripheral perfusion may be impaired in trauma patients, as previously discussed.

Conclusion

Pain that follows injury produces major pathophysiological sequelae. Proper use of various analgesic techniques not only provides comfort during the immediate post-injury period, but also decreases morbidity and shortens patients' hospitalization, as well as it can decrease the likelihood and severity of chronic pain syndromes that may develop. The management of posttraumatic pain requires not only sympathetic minds, but also knowledge, as well as holistic and multidisciplinary approaches, for the best results for the patients.

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กิจกรรมการศึกษาต่อเนื่องสำหรับแพทย์

ท่านสามารถได้รับการรับรองอย่างเป็นทางการสำหรับกิจกรรมการศึกษาต่อเนื่องสำหรับแพทย์ กลุ่มที่ 3 ประเภทที่ 23 (ศึกษาด้วยตนเอง) โดยศูนย์การศึกษาต่อเนื่องของแพทย์ จุฬาลงกรณ์มหาวิทยาลัย ตามเกณฑ์ของศูนย์การศึกษาต่อเนื่องของแพทย์แห่งแพทยสภา (ศนพ.) จากการอ่านบทความเรื่อง **"การบำบัดความปวดในผู้ป่วยที่ได้รับบาดเจ็บ"** โดยตอบคำถามข้างล่างนี้ พร้อมกับส่งคำตอบที่ท่านคิดว่าถูกต้องโดยใช้แบบฟอร์มคำตอบท้ายคำถาม แล้วใส่ซองพร้อมซองเปล่า (ไม่ต้องติดแสตมป์) จ่าหน้าซองถึงตัวท่าน ส่งถึง

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คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย
หน่วยจุฬาลงกรณ์เวชสาร
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เขตปทุมวัน กทม. 10330

จุฬาลงกรณ์เวชสารขอสงวนสิทธิ์ที่จะส่งเฉลยคำตอบพร้อมหนังสือรับรองกิจกรรมการศึกษาต่อเนื่องอย่างเป็นทางการ ดังกล่าวแล้วข้างต้นสำหรับท่านที่เป็นสมาชิกจุฬาลงกรณ์เวชสารเท่านั้น สำหรับท่านที่ยังไม่เป็นสมาชิกแต่ถ้าท่านสมัครเข้าเป็นสมาชิกจุฬาลงกรณ์เวชสารสำหรับวารสารปี 2545 (เพียง 200 บาทต่อปี) ทางจุฬาลงกรณ์เวชสารยินดีดำเนินการส่งเฉลยคำตอบจากการอ่านบทความให้ตั้งแต่ฉบับเดือนมกราคม 2545 จนถึงฉบับเดือนธันวาคม 2545 โดยสามารถส่งคำตอบได้ไม่เกินเดือนมีนาคม 2546 และจะส่งหนังสือรับรองชนิดสรุปเป็นรายปีว่าท่านสมาชิกได้เข้าร่วมกิจกรรมการศึกษาต่อเนื่องที่จัดโดยจุฬาลงกรณ์เวชสาร จำนวนกี่เครดิตในปีที่ผ่านมา โดยจะส่งให้ในเดือนเมษายน 2546

คำถาม - คำตอบ

1. ความปวดที่เกิดจากการบาดเจ็บอย่างรุนแรง มีผลต่อร่างกาย คือ
   - ก. เป็นกลไกการป้องกันตนเองตามธรรมชาติ ซึ่งไม่เกิดผลเสียต่อร่างกาย
   - ข. กระตุ้นให้เกิดหัวใจเต้นเร็ว และความดันเลือดสูง ช่วยพยุงระบบหัวใจและหลอดเลือดในระยะแรก
   - ค. ร่างกายตอบสนองโดยทำให้เกิดการหดตัวของหลอดเลือดเสมอ
   - ง. การทำงานของระบบทางเดินอาหารลดลงแต่ไม่มีผลต่อไต

คำตอบ สำหรับบทความเรื่อง **"การบำบัดความปวดในผู้ป่วยที่ได้รับบาดเจ็บ"**
จุฬาลงกรณ์เวชสาร ปีที่ 46 ฉบับที่ 3 เดือนมีนาคม พ.ศ. 2545
รหัสสื่อการศึกษาต่อเนื่อง 3-15-201-2000/0203-(1006)

ชื่อ - นามสกุลผู้ขอ CME credit ..... เลขที่ใบประกอบวิชาชีพเวชกรรม.....
ที่อยู่.....

1. (ก) (ข) (ค) (ง)
2. (ก) (ข) (ค) (ง)
3. (ก) (ข) (ค) (ง)
4. (ก) (ข) (ค) (ง)
5. (ก) (ข) (ค) (ง)

2. เป้าหมายสำคัญในการระงับปวดจากการบาดเจ็บ คือ
    ก. ลดค่าใช้จ่ายในการรักษาภาวะแทรกซ้อนของผู้ได้รับบาดเจ็บ
    ข. ลดการเกิดภาวะความปวดเรื้อรังที่อาจตามมา
    ค. เพื่อช่วยให้การทำงานของอวัยวะต่าง ๆ กลับคืนมาโดยเร็ว
    ง. เพื่อลดความทรมานให้กับผู้ป่วย
3. ความสำคัญอันดับแรกของการดูแลผู้ป่วยที่ได้รับบาดเจ็บ คือ
    ก. ช่วยระงับปวดเพื่อลดความทรมานแก่ผู้ป่วย
    ข. การช่วยชีวิตผู้ป่วยและคงสภาพของร่างกาย
    ค. การให้สารน้ำและเลือด
    ง. การป้องกันภาวะแทรกซ้อนที่อาจเกิดขึ้น
4. การให้ยาระงับปวดแก่ผู้ป่วยที่บาดเจ็บรุนแรง ระยะแรกควรให้โดยวิธี
    ก. ฉีดเข้าหลอดเลือดดำครั้งละน้อย จนได้ผลระงับปวดดี
    ข. หยดเข้าหลอดเลือดดำตลอดเวลา
    ค. ฉีดเข้ากล้ามเพื่อให้ผลระงับปวดนาน
    ง. ฉีดเข้าใต้ผิวหนัง เนื่องจากทำได้สะดวก
5. การระงับปวดโดยใช้ regional analgesic techniques
    ก. มีผลเสียมากกว่าผลดี เพราะทำให้ความดันเลือดตกได้ง่าย
    ข. ไม่สามารถทำได้ในผู้ป่วยบาดเจ็บที่ศีรษะ
    ค. ควรทำในผู้ป่วยทุกรายเสมอ เพราะให้ผลระงับปวดดี
    ง. มักให้ผลระงับปวดที่ดี และช่วยให้การไหลเวียนของเลือดในบริเวณนั้น ๆ ดีขึ้น

ท่านที่ประสงค์จะได้รับเครดิตการศึกษาต่อเนื่อง (CME credit)
กรุณาส่งคำตอบพร้อมรายละเอียดของท่านตามแบบฟอร์มด้านหน้า

ศาสตราจารย์นายแพทย์สุทธิพร จิตต์มิตรภาพ
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