POSTOPERATIVE PAIN MANAGEMENT IN SPINAL SURGERY

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ABSTRACT :

Postoperative pain is common problem after surgical procedures. Spinal surgery is a group of major surgical procedures in which patients may experience postoperative pain more likely than other minor surgical procedures. We, herein, reviewed pain pathways, responses to postoperative pain and discussed current pain management methods, which are used to relieve pain after spinal surgical procedures.

Key Words: *Spinal surgery, Pain management.*

INTRODUCTION

The International Association for the Study of Pain has defined pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (9). Many of patients worldwide undergo surgery for treatment surgically correctable diseases. Although developments in the postoperative pain control techniques, many patients still continue to experience with severe pain. Clinicians undertreat the postoperative pain for a number of reasons; lack of knowledge, fear of respiratory depression and drug addiction.

Spinal surgery is a group of major surgical procedures in which the patients would experience considerable postoperative pain. We think that the pain control is a work of team and to increase the knowledge about the pain control is basic starting point for solving the problem.

PAIN PATHWAYS

Surgery or trauma produces local tissue damage with consequent release of algesic substances (prostoglandins, 5 hydroxytriptamine, histamine, serotonin, bradykinin, substance P) and generation of noxious stimuli that are transduced by nociceptors and transmitted by A–delta and C fibers to the neuraxis. Further transmission is determined by complex modulating influences in the spinal cord. Some impulses pass to the anterior and anterolateral horns to provoke segmental reflex responses. Others are transmitted to higher centers via the spinothalamic and spinoreticular tracts, where they produce suprasegmental and cortical response (9).

Segmental reflex responses associated with surgery include increases in oxygen consumption and lactic acid production. Stimulation of sympathetic neurones causes tachycardia, increased stroke volume, cardiac work and myocardial oxygen consumption. Tone is decreased in the gastrointestinal and urinary tracts (9). **Suprasegmental reflex responses** result in further increased sympathetic tone and hypothalamic stimulation. Metabolism and oxygen consumption are increased. **Cortical responses** in awake unanesthetised patients after surgery are provoked by nociceptive impulses reaching the highest brain centers where complex systems concerned with integration and perception of pain are activated. Apprehension and anxiety may accompany pain, resulting in additional hypothalamic stimulation (9).

RESPONSES TO POSTOPERATIVE PAIN

Physiological responses to injury and stress include pulmonary, cardiovascular, gastrointestinal and urinary dysfunction and neuroendocrine and metabolic changes. Many of these side effects can be eliminated or reduced with currently available analgesic technique (9).

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Respiratory

Vital capacity ↓

Tidal volume ↓

Residual volume ↓

Functional residual capacity ↓

Forced expiratory volume in one second ↓

Tone in the abdominal muscle ↓

Diaphragmatic function ↓

Pulmonary compliance ↓

Breathe deeply or cough forcefully ↓

Hypoxemia, hypercarbia

Retantion of secretions, athelectasis and pneumonia

Cardiovascular:

Stimulation of sympathetic neurones

Tachycardia

Stroke volume ↓

Cardiac work ↓

Myocardial oxygen consumption ↓

Risk of myocardial ischaemia or infarction ↓

Risk of deep vein thrombosis ↓

Gastrointestinal and urinary:

Hypomotility of bowel

Ileus, nausea or vomiting

Hypomotility of urethra and bladder

Neuroendocrine and metabolic:

Sympathetic tone ↓

Hypothalamic stimulation

Catecholamine and catabolic hormone secretion ↓

Anabolic hormone secretion ↓

Na+, water retention

Blood glucose, free fatty acids, ketone bodies, lactate ↓

A catabolic state and negative nitrogen balance (if the process continues) ↓

Psychological:

The fear of pain

Anxiety

Insomnia

Aggression

MANAGEMENT OF POSTOPERATIVE PAIN IN SPINAL SURGERY

A number of factors may influence the intensity, quality and duration of postoperative pain. The most important of these are the site, nature, and duration of surgery; the type and extent of the incision; the presence of complications related to the surgery; the anesthetic management before, during and after surgery (9). Because spinal operations are major and long lasting operations with considerable tissue damage, pain control is highly important in these patients. Although, the used methods for the treatment of postoperative pain is variable regarding the type and duration of operation, the basic methods are as following:

1. **Nonsteroidal Antiinflammatory Drugs [(NSAİDs (i.v., i.m., orally)]**
2. **Opioids [iv, im, PCA, spinal [(epidural–intrathecal)]**
3. **Local anesthetics (epidural, caudal, intrathecal, peripheral nerve blocks etc.)**

1. NSAIDs

These drugs may be useful after minor surgery and are used to provide analgesia during the later period after major surgery. They are employed also to supplement opioid analgesia after some type of operations such as spinal surgery (1, 4). NSAIDs are generally more effective than the other non–opioid analgesic after surgery or trauma because of their antiinflammatory properties (1).

2. OPİOİDS

The opioid analgesics are drugs, which act on a variety of specific receptors both centrally in the CNS and peripherally. morphine, meperidine (pethidine), fentanyl, alfentanil, sufentanil are the most frequently used drugs in pain therapy. In the postoperative period, morphine was traditionally administered by the **i.m.** route, in a dose of 5–20 mg; the peak effect occur 60–90 minute after administration but there is great variation between individual patients. The duration of action after either **i.v.** or i.m. injection is 3–4 hours. Oral morphine is used in the treatment of chronic pain in the form of morphine sulphate tablets (MST) (1).

Patient Controlled Analgesia (PCA) is becoming standart therapy after major operations such as spinal surgery. The method based on the specially designed

infusion pump in which by pushing a button, patients are able to self–administer precise doses of opioids intravenously (or epidurally/intrathecally) on an as needed basis. The physician programs the infusion pump to deliver a specific dose, the minimum interval between doses (lockout period) and the maximum amount of opioid that can be given in a preset period (usually 1 to 4 hours); a basal infusion can also be simultaneously delivered. When PCA is first initiated, a loading dose of opioid must be given by the medical staff. When an intravenous morphine PCA is used following major surgery (such as correction of scoliosis), most adult patients require 2–3 mg/hr in the first 24–48 hours and 1–2 mg/hr in the following 36–72 hours (8).

Studies show that PCA is a cost–effective technique that produces superior analgesia with very high patient satisfaction. Total drug consumption is less, compared with intramuscular injection. Patients are able to adjust the analgesia according to their pain severity, which varies with activity and the time of day. PCA therefore requires the understanding and cooperative patient, this limits its use in very young or confused patients. The routine use of basal infusion is controversial. Clinicians that advocate a basal infusion suggest it prevents the analgesic level from appreciably decreasing when patients sleep; patients are presumably, then, less likely to awaken in severe pain. However some clinicians argue that because of highly variable pharmacokinetics between patients and sometimes rapid decrease in analgesic requirements observed in postoperative patients, basal infusions are more likely to produce respiratory depression (8).

Most common side effects of opioids nausea, vomiting and itching. Nearly all opioids overdoses associated with PCA have been due to incorrect programming of parameters. The doses of opioids are shown in Table 1 (8).

Although opioids are the most widely used analgesics in PCA practice, Rosenow et al. has been reported the use of new non–steroidal antiinflammatory drug, lornoxicam, with PCA after the lumber disk hernia operation (12). They shown that lornoxicam prevents the pain as effective as morphine with less side effects. The NSAIDs have been used with PCA morphine for prevention of side effects of opioids. In the other studies, morphine PCA plus ketorolac has been used in different doses with the interval of six hours after the spinal fusion operations. Addition of the intravenous ketorolac in the doses of 7,5–30 mg/kg every 6 hours to standart PCA morphine treatment decreased the sedation scores and morphine consumption. The addition of NSAIDs to standart PCA morphine seems to be effective method to control the pain with fewer side effects (10, 11).

Table 1. PCA orders for the average adult.

Opioids	Bolus Dose	Lockout Time (min)	Infusion Rate
Morphine	1–3 mg	10–20	0–1 mg/hr
Meperidine	10–15 mg	5–15	0–20 mg/hr
Fentanyl	15–25 µg	10–20	0–50 µg/hr
Tramadol	20 mg	15–30	5 mg/hr

The authors do not recommend continious infusion for most patients.

Spinal opioids can be used after spinal surgery when there are no contraindications to the use of **intrathecal or epidural technics.** Epidural catheter can be placed via caudal route or directly to epidural space by surgeon during the spinal surgery (2, 3). Bolus administration through an epidural catheter results in analgesia for 6–12 hours and continuos infusion with or without local anesthetic have also been used to provide uninterrupted pain relief for 48 hours or longer (7, 13). Another way of uncut pain relief is **Patient Controlled Epidural Analgesia** (PCEA) (14). Although continuous infusion provides effective and cheap analgesia with low drug concentration, PCEA gives additional dose opportunity to patient according to analgesic requirement. The recommended doses of the opioid and opioid plus local anesthetic in PCEA shown at Table 2 (14). Epidurally administered hydrophilic agents (such as morphine) produce at much lower blood levels than lipophilic agents (such as fentanyl). Epidural morphine 3–5 mg is effective and is more employed. When opioids are given epidurally or intrathecally, opiate penetration into the spinal cord is both time and concentration dependent. When epidural morphine is chosen as a sole analgesic by continuous infusion (0.1 mg/ml), a 3–5 mg bolus is given initially followed by 0.1–0.7 mg/hr infusion. Fentanyl is the most commonly used lipophilic agent and is administered as a 5–10µg/ml solution at 5–10 ml/hr. Table 3 includes epidural opioids doses (8). Recent studies shown that intrathecal

Table 2. PCEA orders for the average adult (14).

Analgesics	Loading dose	Bolus	Lockout time (min)	Infusion rate
Fentanyl+Bupivacaine (2 µg/ml+0.125%)	5 ml	6 ml	15–30	4 ml/hr
Morphine+Lidocaine (0,1 mg/ml+0.5%)	10 ml	5 ml	30–60	1 ml/hr
Morphine (10–20 mg/ml)	2 mg	0.5 mg	30	0.2 mg/hr

Table 3. Epidural opioids.

Opioid	Relative lipid solubility	Doses	Onset (min)	Peak (min)	Duration (hr)	Infusion Rate
Morphine	1	2–5 mg	15–30	60–90	4–24	0.3–0.9 mg/hr
Fentanyl	600	50–100 µg	5–10	15–30	4–6	5–20 mg/hr
Meperidine	30	25–75 mg	5–10	15–30	4–6	5–20 mg/hr
Sufentanyl	1200	20–50 µg	5–15	20–30	2–6	10–25 µg/hr
Alfentanyl	100	250–1000 µg	15	10–15	1–2	150–300 µg/hr

administration of opioids are effective on reducing blood loss intraoperativelly in spinal surgery (6). It has been reported that, morphine–sufentanil mixture given intrathecally before the incision, resulted in a significant reduction of blood pressure without the use of any hypotensive agents and produce prolonged postoperative analgesia (5, 6).

3. LOCAL ANESTHETICS

Local anesthetic solutions alone can provide excellent analgesia but produce symphathetic and motor blockade. These drugs are used via epidurally, intrathecally or infiltration of wound for producing analgesia. While epidural use can cause hypotension, intratechal use limits ambulation. To avoid from motor blockage, the local anesthetics can be used in diluted form without decrease in its anelgesic effect. The most commonly used agent is bupivacaine 0.125–0.25%. Infusion rate must be individualized for each patient but generally depends on the level of the catheter tip relative to the dermatomes of the incision. In an optimally placed catheter, infusion rates of 5–10 ml/hr produce satisfactory analgesia. The mixture of local anesthetics and opioids is preferred to avoid the side effects of local anesthetics, which are hypotension and motor block, and of opioids which are dose dependent. When dilute local anesthetic solutions are combined with opioids, significant synergy is observed. Bupivacaine 0.0625–0.125% combined with morphine 0.1 mg/ml (or fentanyl 5µg/ml) provides excellent analgesia (8).

Currently, intravenous PCA, epidural infusion or PCEA or use of both of them seems the most effect techniques for providing analgesia after the spinal surgery. Opioids or opioids plus local anesthetics are the preferred drugs for analgesic effect. IN CONCLUSION, whatever the technique used, early diagnosis of neurological complications of spinal surgery should be not ruled out by postoperative analgesia.

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