International Journal of Basic and Applied Medical Sciences ISSN: 2277-2103 (Online)
An Open Access, Online International Journal Available at http://www.cibtech.org/jms.htm
2015 Vol. 5 (2) May-August, pp. 51-55/Bhattacharya et al.
Review Article

SEDATION AND ANALGESIA IN CRITICALLY ILL BURN PATIENTS

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ABSTRACT
In the burn critical care unit (BCCU), the emphasis is on resuscitation and monitoring with life support system. Palliation of symptoms was not accorded its due importance. Analgesia and sedation are the primary tools of palliation. With recent advances, the concepts of burn critical care have changed considerably. High quality analgesia, sedation along with resuscitation has become the cornerstone of burn critical care nowadays (Angela *et al.*, 2003; Milve, 2003).

Keywords: *Analgesia, Sedation, Burn, Critical Care Unit*

INTRODUCTION
Burn injury is among the most severe forms of trauma and causes one of the most intense and prolonged type of acute pain. India is the only country in the world where burn was classified among the 15 leading causes of deaths (Nariawar and Meshram, 2004). According to WHO report, fire related burns (injuries due to exposure to smoke, fire and flames) were responsible for an estimated 3,22,000 deaths in the world in 2002 (World Health Organization, 2004). More than half of all fire related burn deaths occur in South East Asia: two out of three of these deaths are among females[4]. More than one million people suffer from moderate to severe burns in India each year (estimate for 1982) (World Health Organization, 2004). Pain is experienced by almost every patient with cutaneous burns. Patients with more severe burns, present with several problems including fluid depletion, haemodynamic instability, airway problems and pain, so they are treated in burn critical care unit (BCCI).
Criteria for admission in critical care unit are (Zaidi *et al.*, 1996):
1. Severe burns in more than 30% TBSA.
2. Burns in extremes of age.
3. Burns with smoke inhalation.
4. High voltage electric burn.
5. Burns associated with other medical problems.

Adequate pain relief is an important task and must be considered on priority while others resuscitation measures are being undertaken.
The depth and area of burn affect the severity of pain which is influenced by psychological trauma of injury and fear of future.

Characteristic of Burn Pain (Choiniere et al., 1989; Pal et al., 1997; Choinere, 2001)
Burn pain can be characterized under the following 4 types.
1. Acute pain – occurs immediately after injury, acute in nature, severest in partial thickness burns.
2. Procedural pain – occurs during procedures like wound cleaning, debridements, burn dressing etc., shorter in duration and greater in intensity.
3. Resting pain – occurs when the patient is lying on bed, constant and dull in nature.
4. Chronic pain – usually continues after procedural pain for months and years an is usually neuropathic in origin.

Factors Affecting Nature and Severity of Pain
Various factors affect pain are (Charton *et al.*, 1983; Karen *et al.*, 1997):
1. Duration of burn – Patients with extensive burns have highest pain intensity during first week of burned period.
2. Depth and area of burn - Patients with superficial burns have pain and erythema where as in partial thickness burns (2^0) pain is severe as the nerve roots are exposed. Patients with full thickness burns 3^0

present with minimal pain but increased level of anxiety. Here pain is minimal as all layers of skin and nerve endings are damaged.

3. Nature of care procedures - Burn dressing, skin grafting, physiotherapy and movement of patient can cause various degrees of pain.
4. Patient characteristics – Age, Sex, and ethnic origin also contribute to the severity of pain.
5. Psychological factors – Influence the distress experienced by the patient. Fear concerning the eventual outcome, including the cosmetic deformity and reaction of the people to it, all greatly affect patients perception and response to pain. Depression, sleep disturbances, anger, apathy, regression, psychosis and suicidal tendency have been reported in patients with burns.

Mechanism of Acute Pain in Burnt Patient

The International Association for the study of pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, and causes the individual to react to remove the noxious stimulus (Kinsella and Booth, 1991; Marvin, 1999).

Pain receptors are divided into three groups (Marvin, 1999).

1. Mechanoreceptors – respond to specific stimuli of mechanical distension.
2. Thermo receptors – respond to stimuli of heat.
3. Polymodal receptors – respond to chemical, heat and mechanical stimuli.

Burn causes tissue damage and inflammation with release of histamine, bradykinin and prostaglandin which are implicated in the generation of pain in the burned area of the skin.

These chemicals sensitize receptors, producing tenderness, hyperalgesia in the area of inflammation Noxious stimuli are transmitted from the periphery to the dorsal horn of the spinal cord by two types of primary afferent nerves:

1. Nonmyelinated slow C fibers: (0.5 – 2 m/sec). They make up about 80% of primary afferents and transmit impulses from polymodal and thermo receptors, thus conveying non-specific pain.
2. Fast A δ fibers: (6-30 m / sec). They comprise 20% of primary afferents and are specific for the site and type of pain.

The dorsal horn of the spiral cord is divided into several laminae. C fibres terminate in laminac II (the substantia gelatinosa) and A δ fibres and in lamina I and V. In these laminae, the primary afferent fibers synapse with interneurones that convey impulses to the ascending spinothalamic and spinoreticular tract on the contralateral side of the spinal cord. Also in the dorsal horn, A – β fibres conveying sensation of vibration and light touch are included in the modification of pain transmission via inhibitory interneurones.

The spirothalamic tract ascends from lamina I & V to the thalamic nuclei, where localization and intensity of pain are appreciated. The spinoreticular tract is formed from lamina V only and connects with both the reticular formation and the medial thalamic nuclei, and is involved in the transmission of deep diffuse pain, in arousal and in emotional responses of fear, distress and suffering. The pain transmission and interpretation is not a unidirectional process and is subjected to peridural and central modification.

There are several components to the acute pain experienced by the patient with cutaneous burn. Burn causes tissue damage and inflammation with release of histamine, bradykinin, prostaglandin, serotonin and leukotrienes which are implicated in the generation of pain in the burned area of the skin (Kensella and Booth, 1991).

Full thickness burns involve the destruction of nerve endings and therefore, the pain experienced may be less than in the areas of partial thickness burns. However it is usual for patients with full thickness burns to have surrounding areas of partial thickness burn which will be painful (Meyer and Campbell, 1981).

Phenomenon of hyperalgesia which is associated with thermal injury in the areas of partial thickness burn and the unburned skin around the injury may cause pain. Hyperalgesia is characterized by decree in pain threshold and development of spontaneous pain, which is mediated by increased sensitization of A fiber nociceptor afferents in the area of burnt (Meyer and Campbell, 1981; Coderre and Melzack, 1987). The process of spinal sensitization is called wind-up may also be implicated in the appreciation of pain from the injured area and in the development of hyperalgesia around the burn (Coderre and Melzack, 1987).

There is also acute increase in β endorphin level which modulate pain sensation response (Edwin *et al.,* 1988). The psychological response of the patient also plays an important role in determining the patient's response to acute trauma. Exacerbation of pain and apprehension are associated with movement and therapeutic manoeuvers. Regeneration of damaged nerve endings causes discomfort. Development of scars and contractures may result in pain and apprehension.

Maintaining an optimal level of comfort and safety for critically ill patients is a universal goal in burn CCU. The American College of Critical Care Medicine of the Society of Critical Care Medicine's practice parameters for the optional use of sedatives and analgesics was published in 1995 and recommended fired approach to the use of sedatives and analgesis (Jacobi *et al.,*).

Why to Treat Burn Pain in Critical Care Unit (Linda and Michael, 2005)

Patient commonly have pain and discomfort from some obvious factors such as:

1. Due to burn injury itself.
2. Patient confined to bed 24 hours / day with limited movement.
3. Patient is attached to different monitoring devices, invasive lines etc. Routine nursing care such as dressing changes, patient mobilization produce pain and discomfort.
4. Physicians & nurse walk in the room throughout day and nights.
5. Patient is apprehensive, anxious, confused and scared.

All these together causes sleeplessness and agitation resulting in tachycardia, increased myocardial oxygen consumption, hypercoagulability, immunosuppression and persistent catabolism (Coderre and Melzack, 1987; Edwin *et al.,* 1988). The combined use of analgesics and sedatives may ameliorate the stress response in critically ill burn patients (Jacobi *et al.,*; Linda and Michael, 2005; Epstein and Breslow, 1999).

In a study conducted by the Royal College of Surgeons and Anaesthetists, it was found that majority of patients do not receive adequate analgesia (Lewis *et al.,* 1994). Samuel (1984) conducted pioneering research on burn pain and denounced the frequent under treatment (Mangano *et al.,* 1992). Burn pain management is decent in elderly, children and in vast majority of population treated on outpatient basis. Use of inappropriate drugs, route of injection, inadequate dose leading to improper absorption and inadequate plasma level of drug resulting in drug tolerance and increased analgesic requirement.

Relieving pain and anxiety makes recovery from burn injury more tolerable, reduces morbidity speeds recovery and helps the patient to cope with their injuries in a more positive manner. Adequate pain control achieved by any method promotes ambulation and movement which in turn dramatically improves pulmonary function, decrease the incidence of venous thrombosis, urinary retention and alleviates psychological distress (Milve, 2003; Choiniere *et al.,* 1989; Epstein and Breslow, 1999; Parker *et al.,* 1995).

Principles of Pain Management

The basic principles of pain therapy consists of I) decreasing the production of chemicals like histamine, serotonin, bradykinin etc. that sensitize the peripheral nerves to pain stimuli (by the anti-inflammatory agents), ii) blocking the release of nociceptive neurotransmitters at peripheral nerve or at the spinal level. This is usually achieved with regional or central neuraxial blockade, iii) stimulating descending pain inhibitory pathways from central nervous system to turn off pain messages at the spinal cord level, which forms the basis of mechanism of narcotic analgesics (Milve, 2003; Parker *et al.,* 1995).

Pain Assessment

Routine assessment of pain intensity in burn patients was first published by Johnsons *et al.,* (1998).

Pain can be measured by objective and subjective methods.

Objective criteria includes, increase in heart rate, blood pressure, cardiac output and respiratory rate and pain related behavior (movement, facial expression and posturing).

Subjective measurements (Spence *et al.,* 1990):

1. Verbal rating scale (VRS)
2. Visual analogue scale (VAS)
3. Numeric rating scale (NRS)

VAS – This is most extensively studied method.
VAS comprises a 10 cm horizontal line with descriptive phrases at either end, from no pain to serve pain. VAS is reliable & valid for many patients but elderly patient may have difficulty with VAS.
NRS – This is zero to 10 point scale and patients choose a number that describes pain with ten representing the worst pain. It is also valid and correlates well with VAS, applicable to patients in many age groups & preferable to VAS in critically ill patients.
Pain assessment and response to therapy should be performed regularly by using a scale appropriate to the patient population and systematically documented.
Pharmacologic Therapy (Perry, 1984; Whispple et al., 1995; Jhonson et al., 1998)
Opioid or narcotic analgesics are the drugs most frequently used to relieve pain in burn critical care unit. They may be used alone or in combination with NSAIDS. Ketamine has an important role as analgesic in critically ill burn patients for bedside procedures – dressing changes and escharotomy (Perry, 1984).
The commonly used opioids in burn critical case unit are (Perry, 1984; Whispple *et al.,* 1995; Jhonson *et al.,* 1998; Carrol *et al.,* 1999).
1. Morphine – produce excellent analgesia and most commonly used for pain relief in burn patients. For immediate pain management repeated small boluses of intravenous morphine 25 to 50 μg / kg / hr careful tifration under strict supervision. Following initial resuscitation patient may remain on morphine intravenous infusion.IM or S/C routes are not used due to erratic absorption.
2. Pethidine – used of procedural pain but is not recommended for background pain because of risk of accumulation of toxic metabolic especially in burn patient with decreased renal clearance.
3. Fentanyl – a potent opioid used for procedural pain. It is suitable in haemodynamically unstable patient, does not liberate histamine, does not accumulate in renal failure continuous infusion dose 0.5 – 1.5 μg / kg / hr.

Transmucosal fentanyl l'olloipos are available analgesia in children with burns.
Alfentanil -- Used for burn dressing and the procedural pain of short duration.
It has a rapid onset (less than 1 minute) and shot duration of action (15 minutes) is associated with stable haemodynamic and absence of respiratory depression. In bolus 10 μg / kg / min produce excellent analgesia.
4. Remitentanil -- Ultrashort acting opioid, metabolized by esterase, does not accumulate but significant bradycardia may occur expensive. Dose 0.6 to 1.5 μg / kg / hr.
5. Tramadol -- Synthetic opioid, centrally acting analgesic with low abuse potential, minimal respiratory depression, better haemodynamic stability and no histamine release. In bolus 1 mg / kg every 4 – 6 hrs. for procedural pain.
6. Ketamine – It is a phencyclidine derivative, good drug for burn dressing in the dose of 1-2mg/kg
7. Clonidine- α_2 agonist, 1-2ug/kg dose provides analgesic effects.
8. Dexmeditomidine- more potnt than clonidine, provides good analgesia.

*Nonpharmacologic Intervention (*Jhonson et al., 1998; Carrol et al., 1999*)*
Proper positioning of the patient, elimination of irritating physical stimulation, application of cold therapy.
Others are TENS / Acupuncture, Music, psychotherapy.

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