**Pain management in critically ill**

**OUTLINE**

* Definition and description of pain
* Importance of pain management in critically ill
* Physiology of pain
* Barriers to pain assessment & management
* Pain assessment: subjective and objective
* Pain management: pharmacologic
* Delivery methods
* Non pharmacological management of pain

**DEFINITION AND DESCRIPTION OF PAIN**

* Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage.
* Pain is recognized as a subjective and multidimensional experience.
* It’s a subjective characteristic implies that pain is whatever the experiencing person says it is and exists whenever he or she says it does.
* Pain management is considered such an important part of care that the American Pain Society coined the phrase ‘pain: the fifth vital sign’ to emphasize its significance and to increase the awareness among heath care professionals of the importance of effective pain management
* Pain is multidimensional phenomenon and includes five components as follows
  + Physiologic component of pain includes genetic, anatomic and physical determinants of pain. This component influence how pain stimuli are recognized and described (noiception)
  + Sensory component of pain includes perception of various characteristic of pain such as intensity, location, quality etc
  + The affective component of pain includes negative emotions such as anxiety and fear associated with experience of pain
  + Behavioral component include the strategies used by the person to express, avoid or control pain such as becoming less physically active or more socially withdrawn. Sometimes patient may become agitated or combative
  + Cognitive component of pain refers to belief, attitudes, memories and meaning attributed to the pain. It also include cognitive coping strategies that people use. This component also determines patient’s goals for and expectations about pain relief and treatment outcomes. Moreover factors that affect cognition such as sedation, dementia, delirium etc alter the response to pain and make it more difficult for observer to assess it.
  + Sociocultural dimension of pain encompasses factors such as demogrpahics (age, gender, education, occupation etc.), support systems, social roles and culture. Families and caregivers influence the patient’s response to pain through their beliefs and behaviors
* The major type of pain are acute & chronic
  + Acute pain is short lasting, usually less than 6 months in duration and implies tissue damage that usually from an identifiable cause.
  + Chronic pain develops when the healing process is incomplete or when there is permanent damage to the nervous system. It lasts for longer period
* Acute and chronic pain can be divided into somatic, visceral or neuropathic origin
  + Somatic pain involves organ such as the skin, muscles, joints and bones. Its location is well defined.
  + Visceral pain involves organ such as heart, stomach and liver. Its location is diffused and can be referred.
  + Neuropathic pain is described as an abnormal sensory process caused by changes in excitability of nerve cells.
    - It is also called as deafferentation pain.
    - This type of pain is associated with the acute inflammatory process or with noiceptive nerve damage that can be caused by surgery or an illness process.
    - The origin of pain may be central or peripheral.
    - Neuraligia and phantom pain are peripheral deafferentation pain whereas cerebrovascular accident can cause central deafferentation pain.
    - This type of pain is difficult to manage and requires multimodal approach

**IMPORTANCE OF PAIN MANAGEMENT IN CRITICALLY ILL**

* Pain is central to the care of the critically ill or injured patient. Many critically ill adult patients experience significant pain during hospitalization. In the intensive care unit (ICU), for example, more than 30% have significant pain at rest, and more than 50% have significant pain during routine care, such as turning, endotracheal suctioning, and wound care.
* Untreated pain can result in negative consequences, including multisystemic complications and the development of chronic disabling pain. These results, in turn, may seriously impact the patient’s functioning, quality of life, and well-being. Furthermore, the absence of pain assessment or an incomplete assessment has been associated with death in the ICU
* Multiple intrinsic and extrinsic sources contribute to the pain including underlying health conditions or disease, trauma, and routine care procedures. Care related pain is a broad concept includes painful procedures such as medical examination, and nursing care.
* Inadequate pain assessment and management have been associated with increased morbidity and mortality rates within the critical care settings.
* Patients’ self- reports were found to be the most valid measure of pain for the patients. Unfortunately, pain is difficult to be assessed within the ICU environment because patients are often unable to communicate verbally due to many reasons such as the severity of the disease, the presence of an endotracheal tube, and sedating agents. However, in the absence of a self- reports, objective or observational pain measurements such as physiological and behavioral indicators can be used as alternative approaches to assess pain. Though some of these measurements show valid evidence for assessing pain in this group, there is no standardized measurement of pain in nonverbal ICU patients. Furthermore, the lack of systemic comprehensive methods for assessing and treating pain in nonverbal ICU patients is one of the barriers to effective pain management in critical care settings. As a result, pain remains underrated and under-treated in most critically ill patients.
* Many patients in ICU are mechanically ventilated, and managing this care is a fundamental component of clinical nursing practice. Pain assessment and management in these patients need to be a priority with routine monitoring, assessment, reassessment, and clear documentation done to facilitate treatment and communication among healthcare members. Documenting of patients’ pain history, its treatment, and its reassessment actions is needed to improve practice and research.
* Appropriate pain management has been shown to be associated with better overall patient results, shorter length of hospitalization, and reduced cost of care.  For these reasons, pain management in the ICUs should be a priority and considered as an ethical obligation for all health professionals

**PHYSIOLOGY OF PAIN**

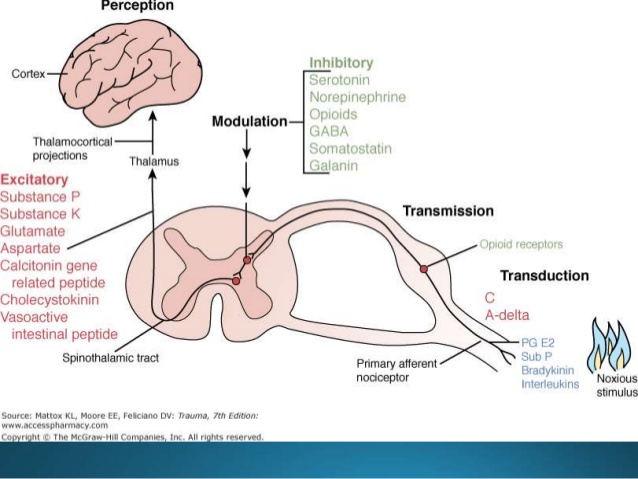
* The sensory experience of pain depends on the interaction between the nervous system and the environment
* The processing of noxious stimuli and the resulting perception of pain involve the peripheral and central nervous systems
* Nociceptors and chemical mediators are involved in transmission and interpretation of pain
* Nociceptorsare also called as pain receptors. They are free nerve ending in the skin that responds only to intense, potentially damaging stimuli.

**NOCICEPTION**

Nociception is the term used to describe how pain becomes conscious. Four processes are involved in noiception: transduction, transmission, perception and modulation **(Image 1)**

* TRANSDUCTION
  + Transduction refers to mechanical, thermal or chemical stimuli that damages tissues.
  + In critical care, many nociceptive stimuli exist including the patient’s acute illness, invasive lines, multiple interventions
  + Theses stimuli also called stressors stimulate the liberation of many chemical substances such and prostaglnadins, bradykinin, serotonin, histamines, glutamate and substance P.
  + These neurotransmitters stimulate peripheral nociceptive receptors and thus serve to initiate noiceptive transmission
* TRANSMISSION
  + As result of transduction, an action potential is produced and is transmitted by nociceptive nerve fibers in the spinal cord that reach higher centers in brain. This is called transmission.
  + The principal nociceptive fibers are the A-delta and c fibers
  + Small diameter, myelinated A delta fibers transmit well localized, sharp pain
  + Small diameter, unmyelinated C fiber transmit diffuse, dull, and aching pain
  + These fibers transmit the noxious sensation from periphery to the dorsal route of spinal cord. With liberation of substance P, these fibers then synapse with ascending spinothalamic fibers to central nervous system.
  + Spinothalamic fibers are clustered in to two specific pathways: neospinothalamic (NS) & paleospinothalamic (PS)
  + Generally, A delta fibers transmit the pain sensation to the brain within NS pathway whereas the C fibers use PS pathway

**Image 1: Stages of noiception**



* PERCEPTION
  + The pain message is transmitted by the spinothalamic pathways to centers in the brain where it is perceived.
  + Pain sensation transmitted by the NS pathway reaches the thalamus, while the pain sensation transmitted by the PS pathway reaches brain stem, hypothalamus and thalamus. These lower parts of the CNS contributes to initial perception of pain
  + Sensory cortex located in the parietal lobe receives projection related to pain from lower parts of brain which allows patient to describe sensory characteristics of pain e.g. location, intensity, quality etc
  + Cognitive component of pain involves many part of cerebral cortex whereas behavioral component of pain involves pain projections to motor cortex located in frontal lobe
* MODULATION
  + Modulation is the liberation of endogenous opioids by the CNS such as beta-endorphins, enkephalins and dynorphins.
  + Endogenous opioids inhibit through the descending pathways the transmission of pain sensation in the spinal cord and produce analgesia
  + These substances link to mu receptors located in nociceptive fibers inhibiting liberation of substance P and blocking the transmission of pain sensation

**BIOLOGIC STRESS RESPONSE TO PAIN**

* Pain is an obvious stressor and activates the biological stress response
* Biological stress response activated by pain allows for the observation of relevant physiologic signs that could be associated with pain
* The biological stress response to pain involves the nervous, endocrine and immune system in the hypo-thalamo-pituitary-adrenal axis.
* In presence of pain hypothalamus releases corticotorpin releasing factor (CRF), which activates the sympathetic nervous system which in turn leads to release of norepinephrine and epinephrine. This may lead to increased heart rate, blood pressure, respiratory rate etc.
* If pain persists for longer duration or injuries are located in bladder and intestine, the parasympathetic nervous system may be dominant. Thus the BP and HR may decrease rather than increase.
* In addition, CRF also stimulates anterior pituitary to release adrenocorticotropic hormone (ACTH) and posterior pituitary to release anti diuretic hormone. ACTH causes aldesterone and cortisol release from adrenal cortex. Aldesterone and ADH causes sodium & water retention which increases intravascular volume and decrease diuresis
* When pain persist over a period of time, cortisol influences immune system for immune suppression and release of cytokines which may lead to execration of tissue damage contributing to chronic pain process.

**PAIN ASSESSMENT**

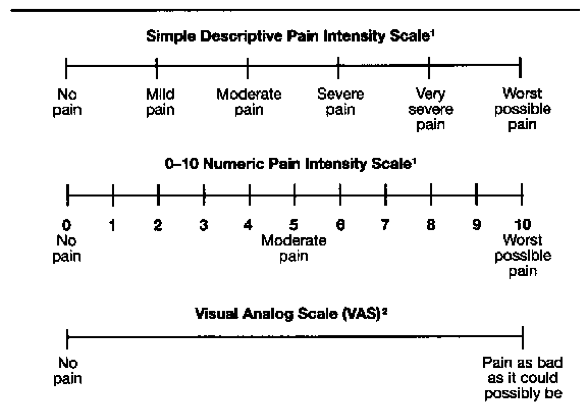
* Pain assessment is vitalpart of nursing care.
* It is essential prerequisite for adequate pain control or relief
* Pain is subjective, multidimensional concept that is complex to assess. Many factors affects verbal communication in critically ill patients making pain assessment more difficult
* Pain assessment has two major component: subjective and objective

**SUBJECTIVE ASSESSMENT**

* Pain is recognized as a subjective experience. Pain is whatever the patient says it is and exists whenever the patient says it does. Thus subjective assessment is most valid measure of pain assessment and must be obtained as often as possible.
* Subjective assessment of pain refers to patients self report of about his or her sensorial, affective and cognitive experience of pain.
* Many intubated patients can communicate having pain or can use pain scale by pointing on tem. Before concluding that a patient is unable to self report, three attempts to ask the patient about pain are recommended. Sufficient time should be allowed for the patient to respond with each attempt
* If cognition level of critically ill patient allows for more information about pain, a multidimensional assessment tools are available e.g Brief Pain Inventory, Initial pain Assessment Tool & short form McGill Pain Questionnaire.
* The patient self report of pain can obtained by based on following characteristics
  + ONSET : - Onset is the time when pain started. Patients with acute pain typically knows when pain started. Those with chronic pain may be less able to identify onset of their pain
  + DURATION: - Duration is establishing how long the pain has lasted. It helps to determine is acute or chronic and assist in identifying etiology of pain
  + PATTERN: - Pattern of pain describes how pain changes with activities or other factors e.g. time of the day, meal timings, certain procedures etc. Many types of chronic pain wax and wane over time e.g. arthritis pain. A patient may have pain all the time (constant) as well as discrete periods of intermittent pain.
    - Breakthrough pain is a transient moderate to severe pain that occurs beyond the pain treated by current analgesics e.g cancer pain. It usually rapid in onset and brief in duration with highly variable intensity and frequency of occurrence.
    - Episodic, procedural or incidental pain is transient increase in pain that is caused by specific activity or even that precipitates the pain e.g. dressing changes, movements etc
  + LOCATION: -The area or location of pain helps to identify possible cause and treatment. Some patient may be able to specify precise location whereas other may describe in more general terms. Patient needs to describe the site(s) of pain, point to painful areas of body or mark painful area on pain map.
    - Referred or radiating pain: pain may radiate from its origin to another site. E.g. angina pectoris radiates from chest to jaw or down to left arm. Radiating pain may be caused because pain gets projected along the course of peripheral nerve e.g sciatica
  + INTENSITY: - assessment of severity or intensity of pain can be reliable measure used to determine the type of treatment and its effectiveness. Pain scales are effective tool to help patient communicate intensity. **(Image 2)** Scales used for measurement of intensity must e adjusted for age & cognitive development of patient. Most adults can rate the intensity of their pain using numeric scales, verbal descriptors scales or visual analogue scale. For nonverbal comatose patients observational tools should be used to detect behaviors that are associated with pain.
  + QUALITY**: -** pain quality refers to the nature or characteristic of pain. E.g. patient with neuropathic pain typically describes it as burning, numbing, shooting, stabbing and itchy sensation. Noiceptive (somatic or visceral) pain may be described as sharp, aching, throbbing and cramping.
  + ASSOCIATED SYMPTOMS: - Patient in pain may experience anxiety, fatigue and depression. These elements in turn may also exacerbate pain. Information about activities or situations which exacerbate or alleviate pain should be collected e.g. activities may exacerbate muscle pain and rest may decrease the pain.

**OBJECTIVE ASSESSMENT**

* Besides the patients self report of pain, observation of behavioral and physiological indicators makes the pain assessment complete and more informative.
* These should not be substituted for self report as long as patient is able to communicate in any way.
* There are various behavioral indicators that may be associated with pain. **(Table 1)**
  + FACIAL EXPRESSION: - brow lowering, orbit tightening, leavtor contraction and eyelid closing have been associated with pain. The presence of first three indicates moderate pain whereas presence of all four facial movements may suggest severe pain. Higher pain intensity is associated with increased number of facial movements. Facial expression of grimacing is an indicator often associated with pain.
  + BODY MOVEMENTS: - body movements can be used by critically ill patients to communicate their pain. Being immobile, moving slowly or with caution, touching the pain site or tubes are associated with critically ill patients self report of pain. Restlessness is often identified as body movement associated with pain

**Image 2. Pain intensity scales** 



* + MUSCULAR TENSION: - it is another potential behavioral pain indicator where patient is tense, rigid, spastic and resistive to being turned
  + COMPLIANCE WITH VENTILATOR: - Although this indicator is widely used for sedation assessment, it is considered as potential indicator of pain in intubated patients. Patient experiencing pain may cough into endotracheal tube and trigger alarms by blocking ventilation.
  + SOUNDS AND VOCALIZATION: - patient’s sounds and vocalizations may be used to assess pain in critically ill extubated patients. Pain related vocalization include sighing, groaning, moaning, crying or sobbing.
* Physiological indicators such as increased mean arterial pressure and increased HR are associated with acute pain caused by noiceptive procedures in critically ill unconscious patients. Physiological indicators are observed when sympathetic nervours system is activated during biological stress response. The vital signs and other parameters monitored in critical care unit can be useful tool to assess the pain of critically ill. Some of these observable indicators were included in tools developed and validated for clinical use in critical care are: PACU Behavioral Pain Rating Scale , Pain assessment and Intervention Notation, Behavioral Pain scale and Critical Care Pain Observation Tool **(Table 2).** Although these tools have limitations, they may help in assessing pain in critical care especially uncommunicative patients.
* Complete pain assessment including subjective and objective component is very essential to ensure that the pain is assessed and controlled/relived in best possible way.

**Table 1: Behavioral and physiologic indicator for pain assessment**

|  |  |  |
| --- | --- | --- |
| **Sr. no** | **Indicator for pain assessment** | **Description** |
| A | **Behavioral** | |
| 1 | Facial expression | Grimacing, frowning, wincing, yes squeezed, teeth clenched, wrinkled brow, teary/crying |
| 2 | Body movement | Immobile, slow/cautious movements, touching the pain sites or tubes, seeking attention though movements, restlessness |
| 3 | Muscular tension | Rigid, tense, stiff, splinting |
| 4 | Compliance with ventilator | Coughing, turning alarms, fighting the ventilator |
| 5 | Sound and vocalization | Groaning, maoning, sighing, sobbing, grunting |
| B | **Physiologic** | |
| 1 | Heart rate | Increase or decrease |
| 2 | Blood pressure | Increase or decrease |
| 3 | Respiratory status | Increase or decrease rate, decrease depth |
| 4 | SpO2 | Decrease |
| 5 | End tidal CO2 | Increase or decrease |
| 6 | Pallor | Skin |
| 7 | Perspiration | General |
| 8 | Pupil | Dilation |

**Table 2: -Critical care pain observation tool (CPOT)**

|  |  |  |  |
| --- | --- | --- | --- |
| Indicator | Description | Score | |
| Facial expression | No muscular tension observed | Relaxed, neutral | 0 |
| Presence of frowning, brow lowering, orbit tightening, levator contraction | Tense | 1 |
| All previous facial movements plus eyelid tightly closed | Grimacing | 2 |
| Body movements | Dose not move at all | Absence of movements | 0 |
| Slow cautious movements, touching or rubbing the pain site, seeking attention through movements | Protection | 1 |
| Pulling tube, attempting to sit up, moving limbs, thrashing, not following commands, striking at staff, trying to climb out of bed | Restlessness | 2 |
| Muscular tension | No resistance to passive movements | Relaxed | 0 |
| Resistance to passive movements | Tense rigid | 1 |
| Strong resistance to passive movements, incapacity to complete them | Very tense or rigid | 2 |
| Compliance with ventilator (intubated patient) | Alarms are not activated, easy ventilation | Tolerating movements | 0 |
| Alarm stops spontaneously | Coughing but tolerating | 1 |
| Asynchrony, blocking ventilation, alarms frequently activated | Fighting ventilator | 2 |
| Vocalization (extubated patient) | Talking in normal tone or no sound | Talking in normal tone or no sound | 0 |
| Sighing, moaning | Sighing, moaning | 1 |
| Crying out, sobbing | Crying out, sobbing | 2 |

**Table 3: Neonate infant pain scale (NIPS)**

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | 0 point | 1 point | 2 point |
| Facial expression | Relaxed | Grimace |  |
| Cry | No cry | Whimper | Vigorous crying |
| Breathing pattern | Relaxed | Changes in breathing |  |
| Arms | Relaxed | Flexed/extended |  |
| Legs | Relaxed | Flexed/extended |  |
| State of arousal | Sleeping/awake | Fussy |  |

Pain level: 0-2 points=no pain, 3-4 points=moderate pain, > 4 points=severe pain

**BARRIERS TO PAIN ASSESSMENT AND MANAGEMENT**

* DIFFICULTY IN COMMUNICATING: - this is most obvious barrier in critically ill patients. Intubated patients cannot verbalize or describe pain. In such case nurse need to reply on physiological and behavioral clues to assess presence and intensity of pain. The patients family may assist in such situation significantly
* ALTERED LEVEL OF CONSCIOUSNESS: - unconscious patients are also capable for pain perception and should be treated for pain in same way as in case of conscious patients. Variety of behavioral and physiological indicators can be identified as reaction to pain in unconscious patients.
* THE ELDERLY: - Some elderly people believe that pain is normal consequence of aging. Delirium, dementia and cognitive deficit presents additional barrier to pain assessment. Observation of behavior is important in this population. Some tools have developed and validated for members of this specific population who often experience chronic pain e.g. checklist for nonverbal pain indicators (CNPI), Discomfort Scale-Dementia Alzheimer’s Type (DS-DAT), Pain assessment checklist for seniors with limited ability to communicate (PACSLAC)
* NEONATES AND INFANTS: - Both term and preterm neonates have anatomical and functional capacity for pain sensation at birth. The premature Infant pain profile **(PIPP)** is valid tool for pain assessment of this population. Many tools have been developed and validated for term neonates and preverbal infants e.g. COMFORT scale, CRIES, Nursing Assessment of Pain Intensity (NAPI), Neonatal infant Pain Scale **(Table 3)** and Scale for Use in Newbrons (SUN)
* CULTURAL INFLUENCES: - Different languages, cultural assumptions by health care team members and cultural influence on patients may affect the communication and assessment of pain. Some patient may think that pain as punishment while some may think it as imbalance in life which may determine their responses to pain.
* LACK OF KNOWLEDGE: - Public knowledge deficit may affect their treatment choices. Some patients and family think that analgesics are addictive so they may underreport the pain. Some may think that pain is part of disease process and may not opt for treatment for the same.
* HEALTH CARE PROFESSIONAL BELIEFS AND ATTITUDE AND LACK OF KNOWLEDGE: - Misconception and lack of knowledge regarding physiological dependence, addiction and drug tolerance among health care professionals may affect pain management of patient. Critical care nurse must remember that pain is what patient state it is and that no additional finding that matches her own understanding is necessary to treat patient’s pain.

**PAIN MANAGEMENT**

* The management of pain in the critically ill is multidisciplinary task
* The control of pain can be pharmacologic, non pharmacologic or combination of two therapies
* Pharmacologic pain management is used predominantly in critical care unit.

**PHARMACOLOGIC CONTROL OF PAIN**

* Pain pharmacology is divided into three categories of action: opioids agonist, nonopioids, and adjuvants
* The pain treatment plan may include medications from one or more of these medication group.
* Mild pain often can be relieved using nonopioids alone. Moderate to severe pain usually requires opioids. Certain type of pain like neuropathic pain may require adjuvant drug.

**OPIOID ANALGESICS**

* Opioids produce their effects by biding to mu receptors in the CNS which leads to
  + Inhibition of the transmission of noiceptive input from periphery to the spinal cord
  + Altered limbic system activity
  + Activation of the descending inhibitory pathway that modulate transmission in the spinal cord
* Opioids are used for both acute and chronic pain. Noiceptive pain is more responsive to opioids than neuropathic pain. But opioids can still be used for neuropathic pain
* The opioids are classified as per their physiological action (pure agonist, mixed agonist-antagonists & Partial antagonist) and binding at specific opioid receptors (e.g. mu, kappa & delta) Pure opioid agonists include morphine, oxycodone, hydrocodone, codeine, methadone, hydroxymorphone and levorphanol. Mixed agonists-antagonist agonists e.g pentzoncine, buterophanol produce less respiratory depression than pure agonists. Partial agonists e.g. buprenorphine binds weakly to mu receptors so has less analgesic efficacy. Partial angonists and mixed agonists-antagonists have limited availability and clinical value in pain management.
* Some opioids are best to avoid as they have less therapeutic value and more toxic effects.
  + Propoxyphene produces toxic metabolite that can cause seizures
  + Meperidine is associated with neurotoxicity
* Some of the important opioids are described in brief here

Morphine

* + Morphine is most commonly prescribed opioid in critical care unit. It is standard by which all other opioids are measured.
  + Water soluble with slower onset and longer duration of action
  + It is used for severe pain
  + It is also viewed an antianxiety drug because of calming effect it produces
  + It reduces myocardial workload by dilating peripheral veins and arteries
  + Ideal for intermittent therapy
  + It has major side effects like excessive sedation, hypotension and respiratory depression

Fentanyl

* It is synthetic opioid preferred for critically ill ptient with hemodynamic instability
* It is lipid soluble and has rapid action and shorter duration
* Effective and safe, preferred for acutely distressed patients
* Rapid administration at higher dosages can cause bradycardia and rigidity in chest muscle wall

Hydromorphone

* It is semisynthetic opioid that has similar action and duration as morphine
* It is more potent than morphine
* It should be used with caution in patients with renal falure as its metabolites can cause CNS toxicity

Methadone

* It is synthetic opioids with morphine like properties but provides less sedation
* It is longer acting than morphine with long half life. Thus it is difficult to titrate in critically ill patients
* It is safer in patients with renal failure as it lacks active metabolites
* It is choice of opioid for patient with long recovery
* Common side effects of opioids include constipation, nausea vomiting, sedation, respiratory depression and pruritus. With continued use, many side effect decreases except constipation. Less common side effect include urinary retension, myoclonus, dizzinesss, confusion and hallucination.
  + Constipation should be managed by gentle stimulant laxatives and stool softener until patient is on opioids because dietary roughage, fluids and exercise alone may not be sufficient.
  + Nausea is common in early phase of treatment as opioids causes delayed gastric emptying. It should be treated with metoclopramide, transdermal scopolamine or prochlorperazine.
  + Sedation is common in opioid naïve patients but reduces as tolerance develops. If sedation is persistent, it can be treated with caffeine, dextroamphetamine or methylphenidate.
  + Clinically significant respiratory depression is rare in opioid tolerant patients. Patients at risk are elderly, opioid naïve, one with underlying lung disease, patient with renal failure and those receiving concurrent other CNS depressants.
    - Monitoring patients before and after opioid administration for Rate and depth of respiration, Level of consciousness, pain intensity, blood pressure and heart rate, sedation level, oxygen saturation and loud snoring
    - If severe respiratory depression develops, naloxone, an opioid atagonists (0.4 mg in 10cc saline) should be given very 2 minutes until patient becomes responsive to physical stimuli or takes deep breath. If patient is on regular opioids, then naloxone should be used judiciously as it may cause agonizing pain, profound withdrawal symptoms and seizures. Continous respiratory monitoring should be done.
  + Pruritus is common with intraspinal routes and can be treated with diphenhydramine

**NON OPIOID ANALGESICS**

* These drugs are widely used in combination with an opioids. They reduce the opioid requirement and provide greater analgesic effect through their action at peripheral and central levels.
* Nonopioid analgesics include acetaminophen and NSAIDs. These agents are characterized by following
  + There is an analgesic ceiling to their analgesic properties (increasing dose beyond their upper limit provide no greater analgesia)
  + They do not produce tolerance or physical symptoms
* Acetaminophen has analgesic and antipyretic action, used to treat mild to moderate pain. It inhibits synthesis of neurotransmitter prostaglandins in the CNS and this is why it does not anti-inflammatory action. Side effects at therapeutic dosages are rare. Larger dosages may lead to damage to liver.
* Nonsteroidal anti-inflammatory drugs in combination with opioids are indicated in patient with acute musculoskeletal and soft tissue inflammation. It blocks the action of cyclooxygenase (COX), the enzyme that converts arachidonic acid into prostaglandins. This action occurs in CNS and PNS component of pain. It is grouped into two categories: first generation (COX-1 & COX-2 inhibitors e.g. aspirin, ibuprofen, ketorolac etc) and second generation (COX-2 inhibitors e.g. celecoxib, rofecoxib). NSAID has many side effects such as gastric ulceration, bleeding, renal failure etc. Ketorolac is most appropriate NSAID for use in critical care. It is safe and effective for post operative pain.
* Aspirin is effective for mild pain but its use as an analgesic is limited because of common side effect of gastric upset, platelet dysfunction and bleeding

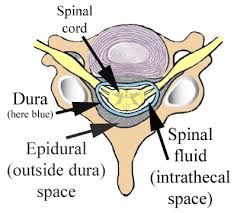
**ADJUVANTS**

* Adjuvants can be very helpful for pain relief in patients with complex pain syndromes such as neuropathic pain.
* Anticonvulsants (carbamazepine, phenytoin, gabapentin) are first line analgesic for lancinating neuropathic pain
* Antidepressants (amitryptiline, imipramine, desipramine) are also considered as an analgesic in variety of chronic pain syndrome such as headache, arthritis, low back pain, neuropathy, central pain and cancer pain. Analgesic dose is generally lower than that requires for depression.
* Corticosteroids (dexamethasone, prednisolone, methylprednisolone) are very commonly used for acute and chronic cancer pain, pain secondary to spinal cord compression & inflammatory joint syndrome. Adverse effects include hyperglycemia, fluid retention, dyspepsia and GI bleeding, impaired healing, muscle wasting, osteoporosis, adrenal suppression & susceptibility to infection
* Anesthetic may also be used in critical care setting. Ketamine is dissociative agent but can be used as an analgesic. It is commonly used for procedural pain and has benefit of sparing respiratory drive over opioids. But it has side effect of release of catcholamine and emergence of delirium. Benzodiazepines may help reduce these side effects
* Lidocaine is another anesthetic agent used for procedural pain

**DELIVERY METHODS**

* The most common route of drug administration for pain control in critical care is intravenous route. Oral route may be used in patients with functioning GI system. But dosages for oral route are higher than required for parenteral route because of first pass effect of hepatic metabolism. Opioids can be given sublingually or through buccal route which may exempt them from first pass effect. Transdermal route may be used in patient with stable pain. Rectal and intranasal route may be used occasionally depending on patient’s condition. Subcutaneous or intramuscular route may be used but are avoided as reapted injection may cause discomfort.
* Intraspinal route has advantages of excellent pain control, lower dosages, increased mobility, minimal sedation, minimal effect on hemodynamic status and increased patient satisfaction. It is particularly useful for pain in throax, upper abdomen and lower extremities and particulary reserved for intraoperative and postoperative use. Patient should be monitored for respiratory status, level of consciousness, urinary retention, pruritus, nausea vomiting and dizziness. There are two intraspinal route: intrathecal and epidural (image 3)
  + Intrathecal opiods are placed directly into CSF and attach to spinal cord receptor. Side effects are post dural puncture headache and infection. It allows more drug to be absorbed in systemic circulation requiring greater dosages compared to epidural route.
  + Epidural analgesia commonly used in critical care unit after major abdominal, thoracic & orthopedic surgeries. It provides long lasting pain relief with minial dosages. Drugs through this route may be bolused or continuously infused

**Image 3: intraspinal spaces**



* There can be continuous infusion, bolus administration or patient controlled analgesia
  + Bolus administration leads to rapid action and ease of titration. But it may also lead to unstable serum level of drug leading to breakthrough pain
  + Continuous infusion provides constant blood levels of drug which may promote consistent comfort. It is helpful during period of sleep. There should be loading dose given before infusion to achieve circulatory dose of drug.
  + Patient controlled analgesia (PTA) is a method of delivery via IV route and an infusion pump, that allows the patient to self administer small doses of analgesics. Most extensively used drug for PCA is morphine. It avoids peaks and valleys of intermittent dosing and gives greater comfort to patient. PTA is not preferred option for patients with advanced age, altered LOC, renal and hepatic insufficiency. Nurse must monitor the effect of medication and number of boluses the patient delivers. She should also advice necessary changes in prescription.

**NON PHARMACOLOGICAL MANAGEMENT OF PAIN**

* Non pharmacologic methods augment and enhance the pharmacologic management of patients pain. Stimulating other non pain sensory fibers (alpha-beta) present in periphery modifies pain transmission. These fibers are stimulated by application heat or cold and simple massage.
* Massage is generalized cutaneous stimulation of body and generally promotes comfort. It usually used for back and shoulder
* Heat and cold therapy may significantly reduce requirement of analgesics. Cold application may also be used for decreasing bleeding. Heat therapy increases blood flow to an area and contribute to pain relief by speeding healing. Patient should be monitored closely to avoid injuries like burns or frost bite.
* Transcutaneous electrical nerve stimulator (TENS) stimulates the non pain sensory fibers for relief of pain. Its use is limited in critical care as it is controlled by patient and requires intact mentation.
* Relaxation reduces the distress associated with pain. It decreases oxygen consumption, muscle tone, heart rate and blood pressure. It also reduces muscle tension and anxiety. Deep breathing exercises may also help patient for relaxation
* Distraction may reduce patient pain and anxiety. Clue can be obtained from family to choose the type of distraction therapy for patient. E.g. watching TV
* Guided imagery uses imagination to provide control over pain. Guiding patient to a place in his or her imagination that is pain free and relaxing takes considerable time commitment on the part of nurse.
* Music therapy can be also used for relaxation. It may have soothing and pleasing effect. It helps in distracting from noises in critical care unit. It should be provided by small set of head phones

**Selected Bibliography**

1. Aitken LM Marshall A Chaboyer W Australian College of Critical Care Nurses. *Critical Care Nursing*. 4e ed. Chatswood NSW: Elsevier; 2019.
2. Woodruff DW. *Critical Care Nursing Made Incredibly Easy!* Fifth ed. Philadelphia: Wolters Kluwer; 2021. [http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=booktext&D=books1&AN=02196142/5th\_Edition. Accessed September 7 2023](http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=booktext&D=books1&AN=02196142/5th_Edition.%20Accessed%20September%207%202023).
3. Burns SM Delgado SA. *Aacn Essentials of Critical Care Nursing*. Fourth ed. New York: McGraw-Hill Education; 2019.
4. Good VS Kirkwood PL. *Advanced Critical Care Nursing*. 2nd ed. St. Louis Missouri: Elsevier; 2018.
5. Urden LD Stacy KM Lough ME. *Critical Care Nursing : Diagnosis and Management*. Edition 9 ed. St. Louis Missouri: Elsevier; 2022.
6. Urden LD Stacy KM Lough ME. *Thelan's Critical Care Nursing : Diagnosis and Management*. 5th ed. St. Louis Mo: Mosby/Elsevier; 2006.
7. Routt M Parks L Oncology Nursing Society. *Critical Care Nursing of the Oncology Patient*. Pittsburgh Pennsylvania: Oncology Nursing Society; 2018. https://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=6125895. Accessed September 7 2023.
8. Lewis SM Bucher L Heitkemper MM Harding M. *Medical-Surgical Nursing : Assessment and Management of Clinical Problems*. 10th ed. St. Louis Missouri: Elsevier; 2017.
9. Hinkle JL Brunner LS Suddarth DS Cheever KL. *Brunner & Suddarth's Textbook of Medical-Surgical Nursing*. 14th ed. Philadelphia: Wolter Kluwer; 2018.