PCA Resource Package

Acute Pain Service

John Hunter Hospital

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INDEX

Aims & Objectives

The aim of this PCA resource package is to develop the reader's understanding of the principles of patient controlled analgesia (PCA), its clinical uses and the factors which influence its efficacy.

By completing this package, you should be able to

- Explain how a PCA system works
- Describe the advantages and disadvantages of PCA
- Understand the rationale behind multi modal analgesia and adjunctive analgesia
- Demonstrate competence in caring for a patient with a PCA system

Outline of Package

This package is comprised of information, PCA prescriptions, recommended readings and policies and procedures related to PCA. A workbook is located at the end of the package. The answers to this workbook are to be found within the package itself or within recommended readings.

Definition of Pain

- ‘An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage’ (IASP).
- “Whatever the experiencing person says it is, existing whenever the experiencing person says it does”. (McCaffery).

Simply defined then, pain is what the patient says hurts.

Pain is a complex experience that involves neurological pathways which transport information to the consciousness and to systems which can modify that experience. Pain is generated by noxious stimuli or by lesions within the peripheral or central nervous systems, but the conscious perception of that pain is influenced by a wide variety of factors including emotions, thoughts and beliefs.

Pathophysiology of Pain

Receptors within the peripheries detect various stimuli such as heat, pressure & touch. When these stimuli become noxious, that is, damaging to tissue; receptors called nociceptors respond and trigger events along a “pain pathway” that establish “pain “ as present. Tissue injury causes cell damage and the release of chemicals collectively known as the “sensitising soup”. These chemicals: Potassium ions, prostaglandins and bradykinins are released from damaged tissue and Substance P is released from nerve endings. This results in increased release of bradykinins & release of histamine, serotonin & noradrenaline. This “sensitising soup” along with changes such as acidosis and ischaemia moderate

the sensitivity of nociceptors, decrease pain thresholds and cause an increased response to painful stimuli.

When nociceptors are stimulated by high velocity or prolonged noxious input; the sensory impulses travel toward the CNS along the sensory nerve trunk by myelinated or unmyelinated primary afferent neurones. These are called Type A fibres & Type C fibres. Type A fibres can be divided into groups called alpha, beta, gamma & delta. The A-delta fibres, which are myelinated and have a small diameter, carry the body's initial response to pain. The stimulation of mechanoreceptors is carried along this pathway primarily; and so results in pain, which occurs immediately post injury and can be felt as sharp, pricking pain. The C fibres are of a smaller diameter and are unmyelinated. The polymodal receptors when stimulated send their noxious stimulus message primarily through these C fibres, which result in “slow” pain, or prolonged, dull aching pain. These primary afferent neurons terminate in the dorsal horn at the presynaptic junction. This action stimulates a release of neuropeptides: Substance P, somatostatin, Glutamate & Aspartate. These bind with receptors on second order neurons creating an action potential.

Endogenous opiates (Dynorphin, Enkephalin, B-Endorphin) bind to opiate receptors located in the dorsal horn at the end of primary afferent fibres and can result in inhibition of the neuropeptides. Therefore the impulse is stopped from progressing.

The spinothalamic tract neurons continue to transmit ascending nociceptive messages to the thalamus and midbrain. The thalamus allows for perception or awareness of pain. The cerebral cortex is responsible for sensory discrimination including quality and significance. The limbic system is responsible for the emotional response to pain and generates incentive and motivational reactions.

The thalamus is also involved in pain modulation or the body's ability to dampen down pain. When the thalamus responds to nociceptive input, the descending or modulatory tract is activated. Serotonin is released by neurons into the synaptic spot in the dorsal horn….where the original neuron takes the serotonin back (reuptake). Neurones from the pons & medulla release norepinephrine in the same way. When reuptake of serotonin and norepinephrine is inhibited, the modulatory tract is further activated resulting in improved inhibition of nociceptive transmission.

Harmful Effects of Pain

Respiratory system: pain from surgery to the chest or abdomen can exaggerate postoperative pulmonary dysfunction, resulting in splinting of the muscles of the diaphragm and chest wall and a reduced ability to cough. This leads to decreased lung volumes, atalectasis, decreased cough, sputum retention, infection and hypoxemia.

Cardiovascular system: severe pain increases sympathetic nervous system activity, resulting in rises in heart rate, blood pressure, and peripheral vascular resistance. These in turn increase the workload of the heart and the oxygen consumption of the myocardium. Severe pain may reduce patient mobility and promote venous stasis. Increases in fibrinogen and platelet activation will increase blood coagability. Both these factors will increase the risk of DVT and pulmonary embolism.

Gastrointestinal & Genitourinary systems: pain can lead to significant delays in gastric emptying, a reduction in gut motility and urinary retention.

Neuro-endocrine & Metabolic systems: pain is believed to play a significant part in the activation of the neuro-endocrine “stress response” seen after surgery or trauma and resulting in the release of a number of hormones. These changes can lead to hyperglycaemia, increased coagulation, increased protein breakdown, impairment of wound healing & immune function.

Psychological effects: inadequately treated pain can lead to or increase patient anxiety, fear, and sleeplessness.

Musculoskeletal system: muscle spasm may further reduce respiratory function

and immobility. This can increase the possibility of venous stasis, DVT & chest infection.

Chronicity: unrelieved severe acute pain can result in the development of persistent (chronic) pain.

Factors that can influence pain

- Cultural and religious beliefs
- Emotional state
- Past experiences of pain & trauma
- Pain tolerance
- The patient's perception of the pain and its effect
- External factors such as health system difficulties, adverse effects of treatment, loss of role/income/control
- Fatigue and sleeplessness

Concept of PCA

The basic principle of PCA is that the patient and the machine interact to form a feedback loop whereby pain triggers a demand by the patient for analgesia, which is met by the machine. If analgesia is adequate then no further demand is made, but if analgesia is inadequate then repeat demands are required.
The administration of analgesia may produce side effects such as nausea, pruritis and dysphoria. The demands for analgesia may be tempered by the existence of these side effects, so that the patient can seek to achieve a compromise between analgesia and side effects.

PCA: Advantages

- Creates patient control & independence over analgesia
- Obviates inherent delays with PRN IMI, SC or oral analgesia
- Negates absorption delays
- Maintains analgesic plasma concentration
- Provides maximal analgesia whilst minimising side effects
- Provides titration of analgesia to the patient's requirements
- Affords greater patient satisfaction
- Affords greater efficiency on busy wards

PCA: Disadvantages

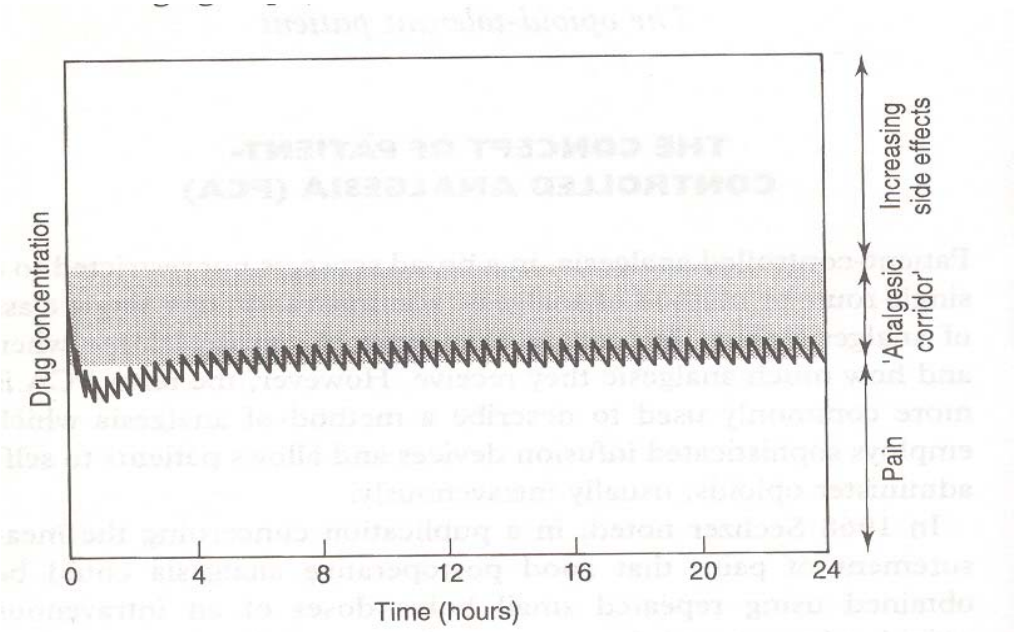
- High cost of equipment: PCA machines & consumables
- The need for staff education

PCA: Contraindications

- Untrained nursing and medical staff
- Patient rejection
- Patient inability to comprehend the technique (eg, language barriers, confusion)
- Extremes of age (children as young as 4 and patients in their 90s can manage PCA, as long as they understand the technique and are willing to be active in their care)

Analgesic Corridor

The range of blood levels where analgesia is achieved without significant side effects is called colloquially the “analgesic corridor”. For each patient the aim of titration is to find and then maintain the effective blood level within this corridor. PCA is more likely to maintain a reasonably constant blood concentration of the drug within the “analgesic corridor” as the patient tempers PCA demands against pain and side effects.



(Macintrye & Ready, p.76).

Definitions

PCA dose: a predetermined dose, which is delivered by the machine when the patient presses the button. The size of the dose is individualised to allow maximal analgesia whilst minimising side effects.

Background infusion: amount of drug infused continuously independent of patient demand. The addition of a background infusion has been shown to decrease the safety of PCA by increasing the risk of respiratory sedation. Sometimes added to aid control of pain at night when patients are sleeping or for patients who have established opioid tolerance due to chronic pain or drug use.

Lockout interval: the period after a dose has been delivered, during which further demands by the patient are ignored by the machine.

4 hr limit: not typically utilised, as undermines the concept of patient control.

Concentration: dose within the solution ie.

30mg Morphine in 30mls is a concentration of 1mg/ml.

900mcg Fentanyl in 30mls is a concentration of 30 mcg/ml.

Safety

- Individualisation of the PCA dose maximises analgesia whilst minimising side effects.
- Programming errors are the most common errors with PCA. Two nurses must always check the PCA program with the prescription when loading new syringes or bags.
- At the commencement of the shift, the nurse assuming patient care should check the PCA program with the prescription, and the patient's observations to avoid any ongoing errors.
- The PCA giving set must be clamped prior to loading a new syringe or bag.
- A designated forked PCA line must be utilised with IV fluids connected to the sideline to ensure maintenance of IV cannula patency.
- Mechanical errors can occur – check pumps & ensure PCA button cord is plugged into the PCA machine.

- **No one** other than the patient may press the PCA button.
- Patients with PCA machines should not leave the hospital environs. Alternative analgesic may need to be found if a patient wishes to go outside frequently or for long periods.

Success of PCA?

To ensure success of PCA, the patient -

- Must be given ongoing education
- Should be encouraged to use the PCA device prophylactically
- Must not be disconnected to aid ADLs, ambulation, physiotherapy.

Complications

Inadequate analgesia: educate patient regarding use of PCA and encourage use of PCA more frequently. Consider surgical review as there may be a surgical cause if pain significantly or suddenly becomes worse despite PCA. Notify APS to review patient if continued inadequate analgesia. Encourage increased PCA use prior to potentially painful activity.

Incompetent / Unable to comprehend PCA: educate patient regarding use of PCA and encourage use of PCA more frequently. If patient seems to have continued difficulty in comprehending PCA then notify APS to consider alternative analgesia.

Pruritis: if opioid related is usually across face and/or chest. Notify APS. Opioid change will be considered as well as the addition of Promethazine to relieve symptoms. If patient is experiencing only slight pruritis then often this will settle after approximately 12-24 hours post opioid commencement. If continued troublesome pruritis is experienced then a Naloxone infusion may be required.

Nausea: administer anti-emetic(s) as charted. Notify APS if the patient continues to experience nausea. Opioid change will be considered as well as change or addition of anti-emetic. Rarely, a Naloxone infusion may be required. The PCA bolus dose may be reduced and the duration of the dose delivery may also be increased if appropriate.

Hallucination / Confusion: Consider there may be contributing factors such as withdrawal, environment etc. Opioids are generally not the sole cause. Notify APS. Opioid change may be considered. As the patient may press the PCA inappropriately then alternative analgesia may be required.

Respiratory Depression: The best early indicator for respiratory depression is sedation. Patients utilising PCA should be able to wake easily and stay awake during conversation. Notify APS if this is not the case. If the patient is frequently drowsy, has a respiratory rate > 8, but is easy to rouse then a reduction of the PCA dose is indicated. If the patient is frequently drowsy, easy to rouse but has a respiratory rate < 8 then a small dose of Naloxone may be warranted in addition to dose reduction. Repeated doses of Naloxone may be required due to Naloxone having a shorter half-life than most opioids. Ensure well - meaning relatives and friends do not access the PCA.

Urinary Retention: May occur due to opioid administration. Pt will require an IDC.

Inhibition of GI motility: is a consequence of opioid administration. Treatment should be anticipatory. Post abdominal surgery some patients will experience wind pain related to the resumption of peristalsis. The use of opioids to treat this discomfort will further inhibit the return of bowel function therefore the patient should be encouraged to mobilise.

Hypotension: opioids do not usually cause hypotension; however they may unmask an underlying hypovolaemia. Contact treating team.

Nursing Considerations

- Two people must programme the PCA pump at all times and check programme with prescription when loading the PCA.
- Check the PCA settings with the prescription; the amount left in the syringe & patient observations at the beginning of each shift or when assuming care of a patient.
- Educate the patient to use the PCA prophylactically as well as for treating pain.
- The PCA button must not be pressed by anyone other than the patient.
- The patient requires another modality if they are unable to understand the concept of PCA.
- Do not disconnect the PCA from the patient prior to showering, sponging, physiotherapy nor ambulation as these activities are potentially the most

painful activities performed.

- Be mindful of patients taking PCA machines outside the ward area.

Adjuncts

These are used in conjunction with opioids to enhance analgesia. The use of multi modal analgesia allows lower doses to be utilised and therefore less side effects may be experienced. Regular use of adjunctive analgesia can enable a reduction in the patient's requirements for opioids. Commonly, Paracetamol and non steroidal anti inflammatories (NSAIDs) (eg. Naprosyn, Ibuprofen) are utilised as adjuncts. Limited doses should be prescribed as these medications have a ceiling effect. Other medications such as Amitriptyline or Clonidine may be used to enhance analgesia and/or aid sleep.

Subsequent Analgesia

PCA is usually ceased once the patient is tolerating fluids. There should be an overlap of analgesic therapy to enable smooth transition from parenteral to oral analgesia and so avoid a period of inadequate analgesia. The patient's PCA opioid requirements can be utilised to guide their subsequent oral opioid dose.

Workbook

Q1. Describe the conceptual basis of PCA.

Q2. Describe what is meant by a “background infusion” and on what occasions might this be prescribed.

Q3. a) What is the concentration if Morphine 90 mg is in 30 mls?

b) What is the concentration if Fentanyl 600mcg is in 30 mls?

c) What is the concentration if Fentanyl 1000mcg is in 50 mls?

d) What is the concentration if Morphine 100 mg is in 50 mls?

Q4. Why is a “four hour limit” not routinely prescribed for PCA?

Q5. A patient with a Morphine PCA is found to be significantly drowsy responding only to loud voices and shaking. His girlfriend tells you that the patient has had a lot of pain and that she has been “helping” him with his PCA. What would be your actions?

Q6. Your patient with a PCA wishes to go outside for a walk around the hospital. What would be your actions?

Q7. Why would regular Paracetamol be prescribed considering the patient is already on a Morphine PCA?

References and Recommended Readings

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