Analgesia

The modern approach

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What is pain?

An unpleasant sensory and emotional experience associated with actual or potential tissue damage.

(Melzac and Wall)

How is pain generated?

Pain is initiated by the stimulation of sensory nerve endings in the skin or body tissues by physical deformation of the ending or by the presence of chemicals released as a result of inflammation or tissue damage (eg histamine, prostaglandins)

Electrical impulses are transmitted from these endings along sensory nerves to the spinal cord and thence to the brain stem. In the brain stem these electrical impulses are amplified and modulate the activity of those areas that control the automatic functions of the body. In this way pain can produce a rise in BP and pulse rate, sweating etc.

How is pain generated?

From the brain stem, impulses are then relayed to the cerebral cortex where they are processed, localised and perceived as pain. The perception of pain can be modified in the cortex by the psychological and emotional state of the patient, as these factors influence the processing of the electrical signals, partly via the release of endogenous opioids (endorphins and enkephalins).

The Gate Theory

- Electrical signals arising as a result of a noxious stimulus can be modified within the spinal cord by the action of gating mechanisms.
- When the gate is open, information is transmitted to the brain and perceived as pain. If the gate is partially or fully closed, the amount of information reaching the brain is reduced and hence the perceived pain is less.

Factors influencing the gate

1) Past physical and emotional experience of pain
2) Anxiety & fear
3) Coexisting non-noxious stimulation;- rubbing a painful area often reduces the perception of pain in that area.
4) Drugs acting on spinal cord (e.g. opioids)

Treatment of pain

The sensation of pain can be modified by interference with the transmission of the electrical signal at any point in this pathway, or by altering the processing of these signals in the cerebral cortex.

1) Preventing the generation of impulses by the sensory nerve endings.

2) Preventing the transmission of electrical impulses along sensory nerves to the spinal cord and thence to the brain

3) Altering the modulation of electrical impulses within the cerebral cortex and hence the appreciation of pain, including psychological management

The modern approach is termed balanced analgesia using a combination of the above.

Non steroidal anti-inflammatory drugs (NSAIDs)

The NSAIDs inhibit the activity of enzymes (cyclo-oxygenases) that manufacture some of the pain inducing chemicals and hence prevent the chemical activation of the sensory nerve endings. Similar enzymes also exist in most tissues and control other vital functions, the inhibition of these enzymes resulting in many of the side effects seen with NSAIDs.

Side effects of NSAIDs

- Bleeding as a result of the inhibition of enzymes involved in the production of the sticky surface of platelets. These drugs should not be used in patients at high risk of haemorrhage (eg following vascular surgery)
- Peptic ulceration as a result of the inhibition of enzymes that produce the protective mucous coating that lines the stomach and helps it resist attack from the acid it produces in gastric digestive juice.
- Bronchospasm can be precipitated by NSAIDs in susceptible individuals and should not be used in asthmatic subjects.
- Acute renal failure especially in patients with pre-existing renal disease. Usually reversible on cessation of treatment.

Some of the newer NSAIDs produce less side effects due higher specificity of enzyme inhibition. (COX 2 inhibitors e.g. Viox)

Contraindications to NSAID therapy

- 1) Known hypersensitivity to NSAIDs
- 2)Pre-existing renal disease
- 3) Potential renal impairment as a result of surgery or drug therapy
- 4)Asthmatic patients who have not received NSAID therapy previously without incident (includes aspirin)
- 5)Patients with coexisting peptic ulcer disease or symptoms of dyspepsia
- 6) Patients with known bleeding disorders or at high risk of haemorrhage

Opiates

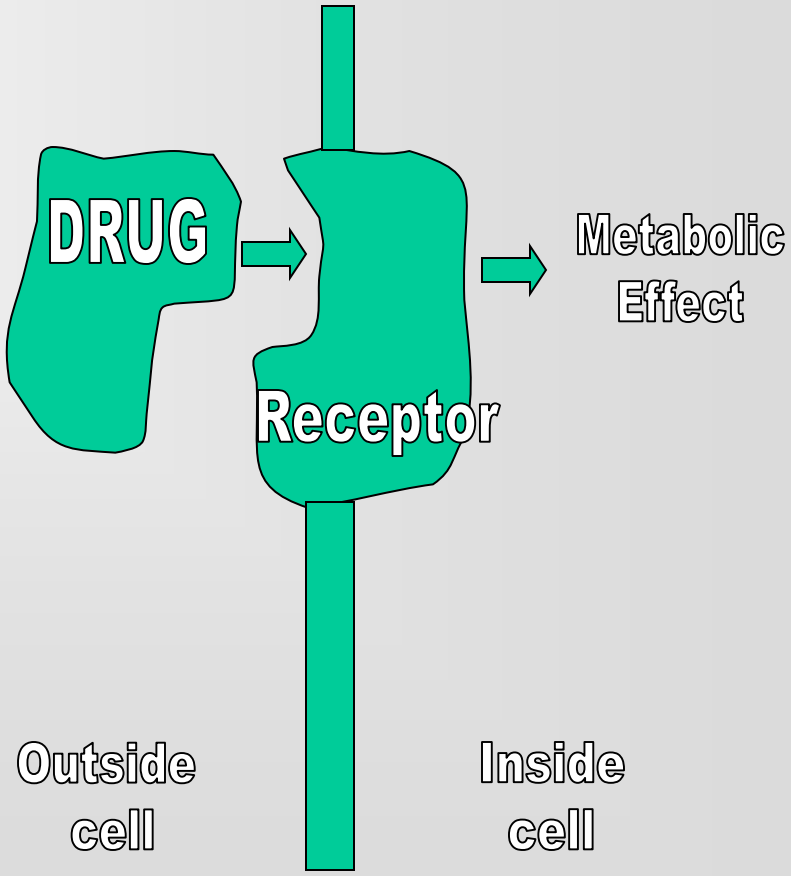
These drugs act by combining with specific receptors in the CNS. This drug/receptor interaction alters the processing of the electrical information received by the cerebral cortex and in this way alters the perception of pain.

There are also opiate receptors at other sites and their combination with opiate drugs results in the side effects seen.

Receptors

When a drug combines with its receptor, a conformational change occurs.

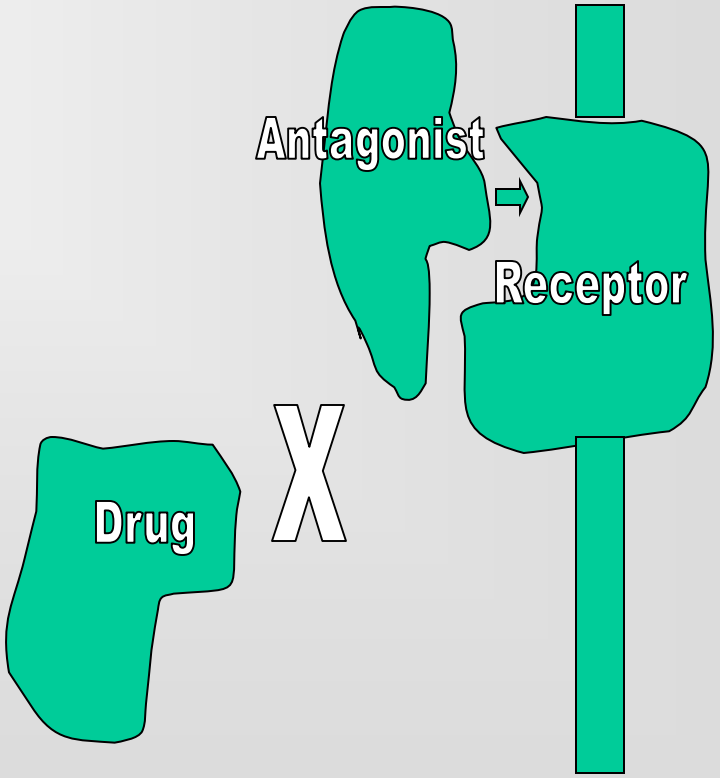
This results in an activation or inhibition of intracellular mechanisms producing a metabolic effect.



Receptor antagonists

These compounds bind to the receptor and prevent activation of the receptor by the drug.

They do not produce a conformational change in the receptor and hence the metabolic effects are not initiated.



Opiate side effects

- Respiratory depression due to interaction with opiate receptors in the respiratory centres of the brain stem, thus reducing sensitivity to carbon dioxide and reducing respiratory drive.
- Sedation due to interaction with opiate receptors in the limbic system of the brain stem.
- Euphoria due to interaction with receptors in the brain stem and cerebral cortex. The feel good factor.
- Nausea and vomiting due to effects on the vomiting centre and chemoreceptor trigger zone in the brain stem, and due to a slowing of gastric emptying.

Opiate side effects

- Constipation due to a reduction in gastrointestinal motility.
- Addiction Not a problem in the short term use of opiates for analgesia in the presence of acute pain.
- Histamine release can occur with some opiates (eg morphine) in susceptible individuals producing bronchospasm, hypotension and itching. These opiates should thus be used with care in such patients.

Treatment of opiate side effects

- All can be reversed by the use of naloxone, a drug that separates an opiate from its receptor at any site. Thus treatment of side effects with naloxone will also reverse the analgesia. Naloxone has a very short half life, shorter than most opiate drugs, therefore a single dose will usually wear off before the opiate has been cleared from the body resulting in a return of its effects.
- Itching can be treated by the use of antihistamines (eg piriton)
- Nausea and vomiting can be treated with anti emetics that reduce the activity of the vomiting centre (eg cyclizine) Metaclopramide has the additional effect that it also speeds up gastric emptying thereby further reducing the nauseating stimulus.
- Respiratory depression may be treated by the use of doxapram, a non specific respiratory stimulant.

Patient controlled analgesia

Intravenous PCA was first developed in the 1960s as a way to control post op. pain. There were simple hand held, spring loaded clamp devices that controlled a set infusion rate. From this the first commercially available product was the Cardiff Palliator. Due to the advances in microchip technology PCA machines became smaller, easier to programme, and more reliable.

Benefits of PCA

- The quality of pain relief is superior to that achieved with either intermittent intramuscular injections or continuous intravenous infusions of opiates.
- There is less nausea and vomiting
- The analgesia is prompt and independent of the availability of nursing staff ***(The average time for nurses to draw up and administer IM analgesia is 20mins. following the patients request)***
- Severe respiratory depression is less common than with intermittent IM injection or continuous IV infusion.
- Can be used safely in children

Hazards of PCA

Prescription errors

- Wrong dose
- Wrong lockout time
- Wrong infusion rate

Administration errors

- Wrong concentration prepared
- Wrong interpretation of prescription
- Incorrect positioning or absence of an anti siphon valve
- Accidental injection when replacing syringe

Patient factors

- Confused or hypoxic patients are unable to control PCA
- Intentional abuse
- Accidental administration
- Altered patient response to the drug
- People other than the patient pressing the button

Contraindications to I.V. PCA

- Patient refusal.
- Lack of patient understanding.
- Inability to use pumps.
- Lack of suitably experienced carers/monitoring for the duration of the infusion.
- Allergy to drugs used.
- (Cardiorespiratory/neurological compromise)

Standard I.V. PCA regimen

- Morphine 1mg/ml
- Initial loading dose to establish analgesia
- Patient initiated bolus dose of 1mg
- Lockout time 5mins

Combination with oral analgesics such as NSAIDs, paracetamol e.t.c. improves effectiveness and reduces the incidence of side effects.

Monitoring patients with I.V. PCA

Patients must be monitored for the duration of their PCA infusion and for 4 hours after discontinuation.

Minimum monitoring standard once established

Pain and nausea scores, Respiratory rate, Blood pressure,

Oxygen saturation **AT LEAST 4 hourly.**

All patients with an oxygen saturation of <95% MUST be given oxygen.

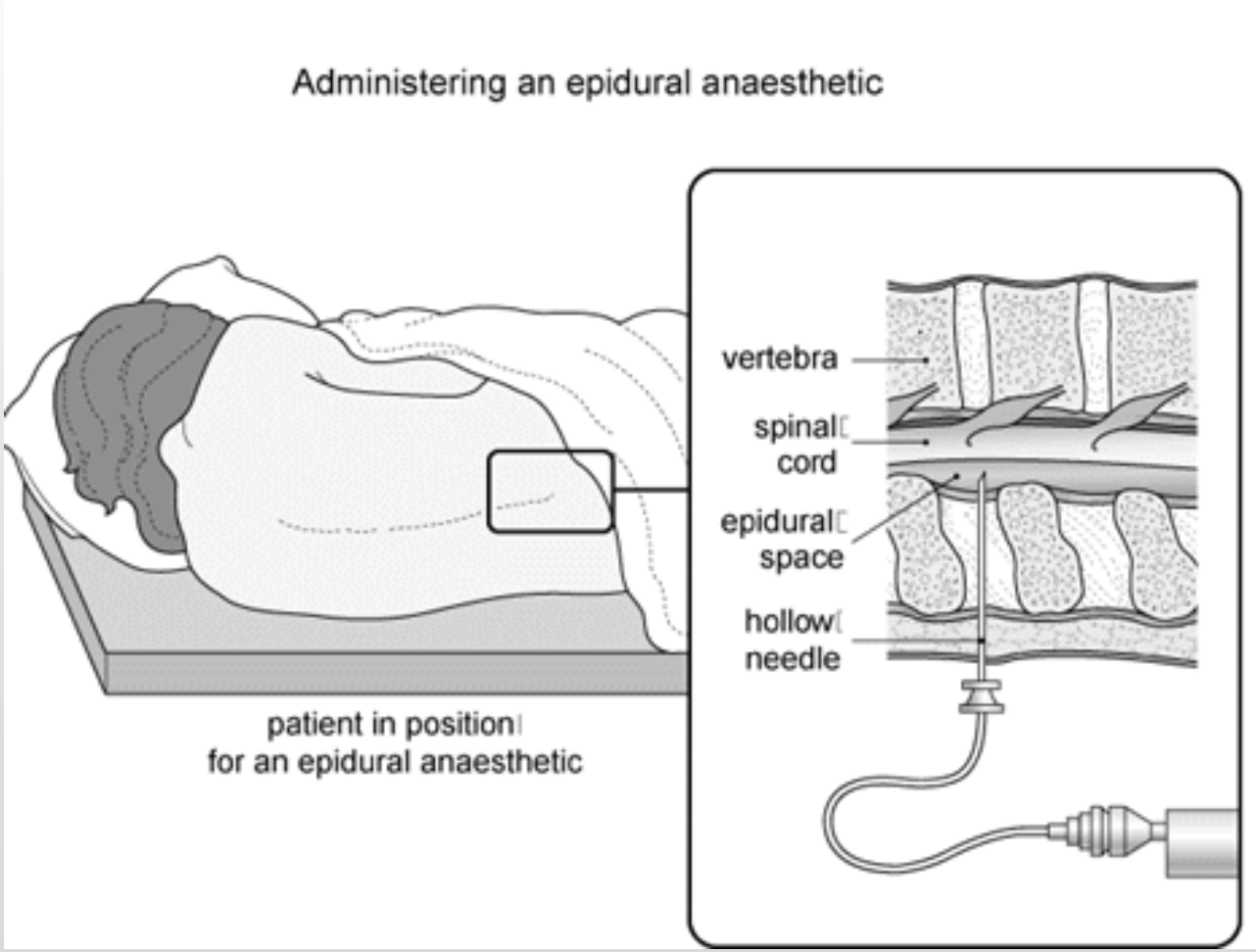
Epidural analgesia

Epidural analgesia is a method of blocking the nerve roots of the spinal cord using local anaesthetic or opiate solutions.

Uses of epidural analgesia

- As the sole method of anaesthesia particularly for procedures on the lower limbs
- Pain relief in obstetrics for caesarean section and labour
- For the administration of post op. analgesia by repeated bolus injections, continuous infusion or PCA

Insertion of an epidural catheter



General complications of epidurals

- Inability to locate epidural space More common in obese patients and those with bony spinal abnormalities (arthritis, previous injury e.t.c)
- Missed segment If there are adhesions within the epidural space the administered solution may not be able to spread evenly
- Introduction of infection potentially leading to epidural abscess, meningitis or encephalitis
- Spinal injection which may lead to cardiovascular collapse and cardio-respiratory arrest as a result of cephalad spread of the injected solution

General complications of epidurals

- Epidural haematoma The epidural space contains a plexus of veins. If one of these is punctured and bleeding does not stop quickly, the resulting haematoma may compress the spinal cord resulting in paralysis
- Intravenous injection into one of the epidural veins. Can result in respiratory arrest and/or cardiac arrest
- Spinal cord injury leading to paralysis. More common in thoracic epidurals.

Contraindications to epidural analgesia

- Patient refusal
- Infection (injection site or systemic)
- Bleeding tendency due to disease or drugs (including aspirin and subcutaneous heparin).
- Lack of the immediate availability of resuscitation equipment/skills/drugs.
- Lack of availability of suitably experienced carers or monitoring for the duration of the infusion.
- Drug allergy.
- (Cardiovascular instability, Neurological deficit)

Epidural opiates

In the late 1970s it was found that in the spinal cord there were specific receptor sites for opiate drugs. When opiate drugs bind to these receptors, the onward transmission of a noxious impulse is blocked. Normally these stimuli would have travelled to the spinal cord, thence on to the brain stem and onwards to the cerebral cortex where these electrical signals are interpreted as pain.

Side effects of epidural opiates

Common

- Itching
- Nausea/vomiting

Rare with low dose infusions

- Respiratory depression
- Sedation
- Hypotension

The side effects of epidural opiates are treated in the same way as when intravenous opiates are administered.

Epidural local anaesthetics

Local anaesthetics (eg bupivicaine) produce pain relief by sensory nerve block, but they also produce motor and sympathetic blockade resulting in muscle weakness and hypotension.

Side effects of epidural LAs

- Muscular paralysis due to motor nerve block. If the local anaesthetic spreads upwards along the vertebral canal it may reach the point where it affects the muscles of respiration. A rise in the anaesthetic effect of an epidural local anaesthetic drug to a point above the nipple line indicates that this may become a problem and the infusion should be stopped immediately. This is unlikely to occur with low dose infusions of dilute solutions as used in the combinations recommended in the current guidelines
- Urinary retention due to loss of the motor nerve supply to the bladder. May necessitate catheterisation.

Side effects of epidural LAs

- Hypotension due to autonomic blockade and paralysis of the muscles in blood vessels resulting in vasodilatation. This can be treated initially by rapid i.v. fluid infusion but may require the use of vasoconstrictor drugs such as ephedrine or methoxamine, either by bolus injection or continuous infusion.
- Local anaesthetic toxicity resulting in perioral tingling, cerebral excitation(fits), asystolic cardiac arrest.

Current concepts

By using a combination of low doses of epidural local anaesthetics and opiates, thus minimising the side effects of both, we can have a patient who is pain free and will be mobile within a few hours of the completion of surgery.

Epidural analgesia can be administered by intermittent bolus injection (more likely to develop hypotension etc.), continuous infusion, or PCA.

Typical epidural opiate/local anaesthetic PCA regimen

- 0.1% marcain or chirocaine containing 5mcg/ml fentanyl
- Initial loading dose to establish analgesia
- Continuous background infusion of 1-3ml/hr
- Patient initiated bolus of 1ml
- Lockout time 8mins

Epidural infusion/PCA

All epidural analgesic regimens should be accompanied by systemic, non-opioid analgesia where possible.

This will reduce the doses of epidural solutions required and facilitate weaning from epidural to less invasive methods of analgesia.

Drugs such as paracetamol and NSAIDs work very well using this approach.

Monitoring patients with epidurals

Patients must be monitored for the duration of their epidural infusion and for 12 hours after discontinuation. Epidural catheters must not be inserted or removed within 8hrs of heparin administration.

Minimum monitoring standard once established

Pain and nausea scores, Respiratory rate, Blood pressure

Oxygen saturation, Mini- neurological exam **AT LEAST 4 hourly.**

Inspection of catheter insertion site **AT LEAST DAILY**

All patients with an oxygen saturation of <95% MUST be given oxygen and intravenous access MUST be maintained at ALL times.

Monitoring pain scores

Word Category Rating Scales

Pain Intensity	Pain Relief
Severe 3	Complete 4
Moderate 2	Good 3
Slight 1	Moderate 2
None 0	Slight 1
	None 0

Visual Analogues

Pain Relief Scale

Pain Intensity Scale