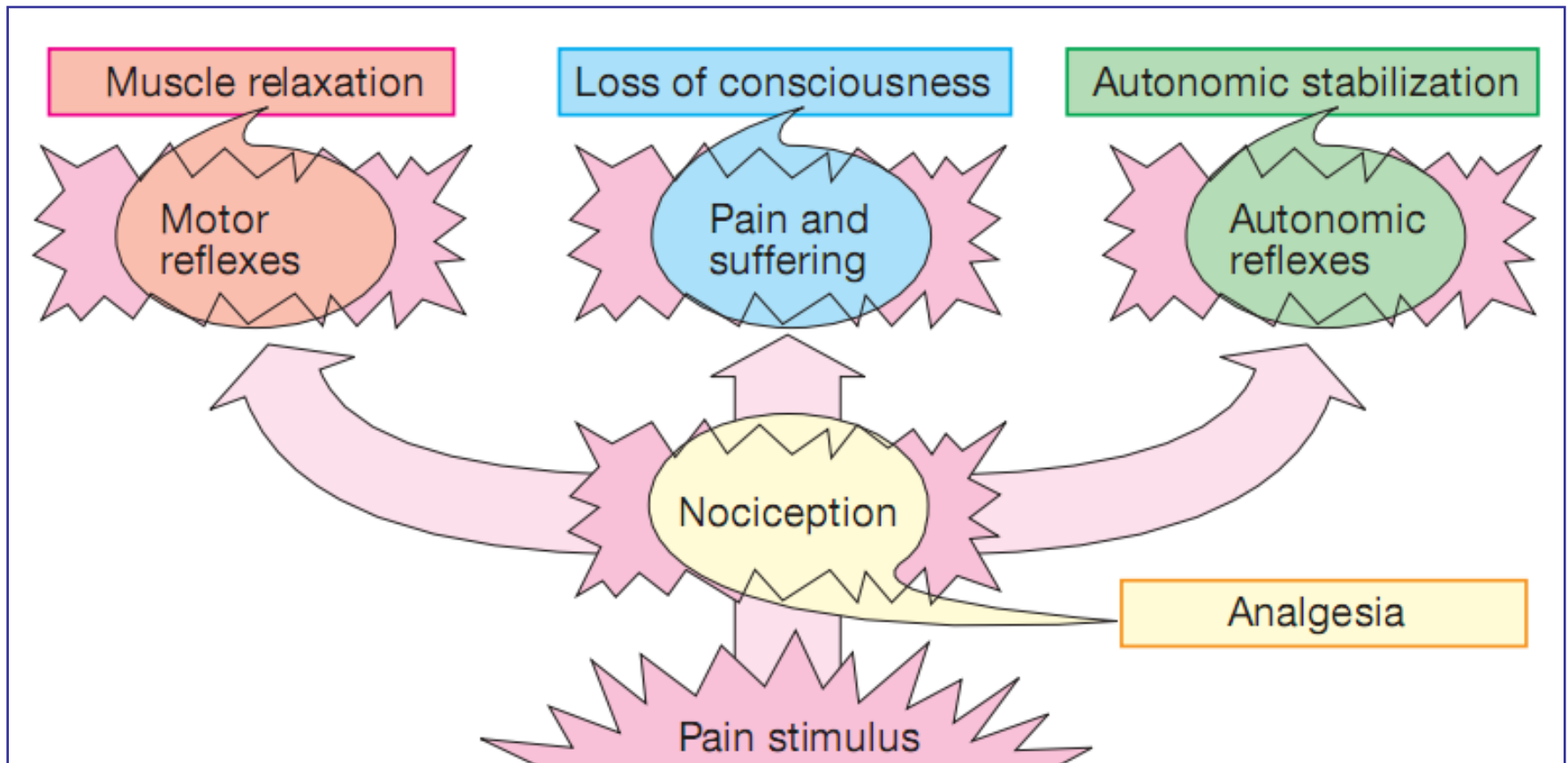


# General anesthesia

- General anesthesia is essential to surgical practice, because it renders patients analgesic, amnesia, and unconscious reflexes, while causing muscle relaxation and suppression of undesirable reflexes.
- No single drug capable of achieving these effects both safely and effectively.
- Potent general anesthesia are delivered via inhalation and intravenously.
- Anesthesia can be divided into three stages: induction, maintenance, and recovery.



# ***Goals of surgical anesthesia***

# General anesthesia

- Induction is the period time from onset of administration of the anesthetic to development of effective surgical anesthesia.
- General anesthesia is normally induced with an intravenous anesthesia that produce unconsciousness within 1 minute or so.
- After that, additional inhalation or intravenous drugs comprising anesthesia. The selected anesthesia combination is given to produce the desired depth of surgical anesthesia
- For children, without intravenous access, moderate agent, such as halothane are used to induce general anesthesia.

# General anesthesia

- Maintenance provides a sustained surgical anesthesia.

Usually done by administration of volatile anesthesia, because these agents offer good minute-to-minute control over the depth of anesthesia.

- Recovery is the time from discontinuation of the administration of the anesthesia until consciousness and protective physiological reflexes are regained. Recovery is reverse of induction,

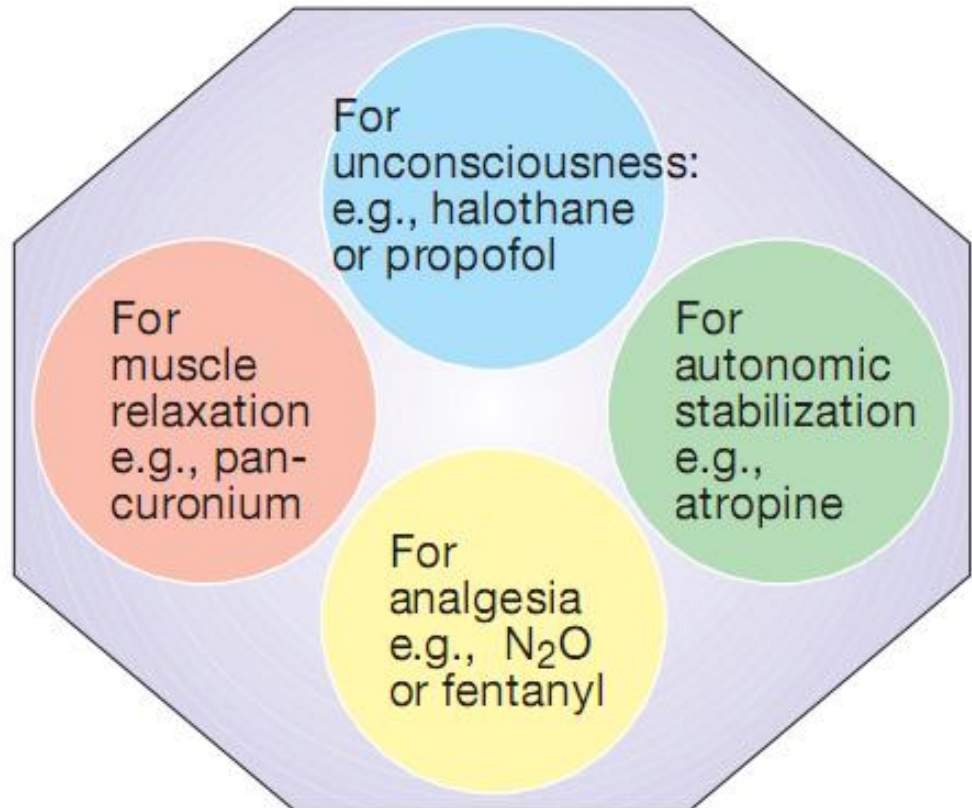
Mono-anesthesia  
e.g., diethylether

Reduced pain  
sensitivity

Loss of consciousness

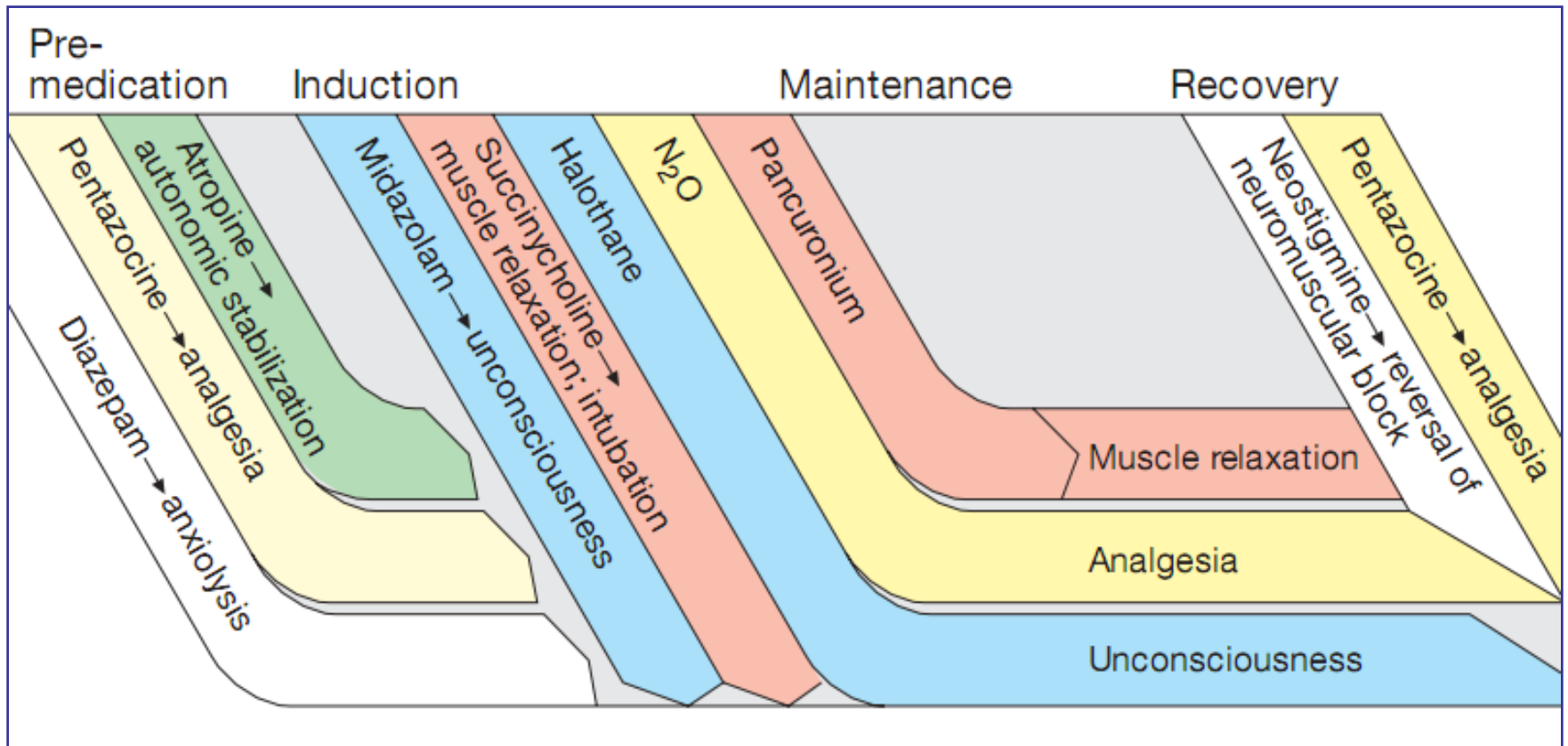
Muscle relaxation

Paralysis of  
vital centers



## ***Traditional monoanesthesia vs. modern balanced anesthesia***

Inhalation anesthetics are not particularly effective analgesics and vary in their ability to produce muscle relaxation; hence if they are used alone to produce general anesthesia, high concentrations are necessary. If inhalation anesthetics are used in combination **with specific analgesic or muscle-relaxant** drugs the inspired concentration of inhalation agent can be reduced, with an associated decrease in adverse effects. The use of such drug combinations has been termed balanced anesthesia.



## ***Regimen for balanced anesthesia***

# Inhalation anesthesia

- Inhaled gases are the core of anesthesia, and are used primarily for the maintenance of anesthesia after administration of an intravenous agent.
- No one anesthetic is superior to another under all circumstances.
- The potency of inhaled anesthesia is defined quantitatively as median alveolar concentration (MAC).

# Inhalation anesthesia

- MAC is the minimum alveolar concentration of anesthetic that produces immobility in 50% of patients exposed to a standard noxious stimulus.
- MAC is usually expressed as a percentage of gas mixture required to achieve the effect, and is small for potent anesthetics.

# Inhalation anesthesia

- No specific receptors has been identified as the target of general anesthesia action.
- The fact that chemically unrelated compounds produce the anesthesia state argue against the existence of such receptors.
- The focus is now on interaction of inhaled anesthetics with proteins comprising ion channels.
- For example, the general anesthesia increase the sensitivity of the gamma-aminobutyric acid (GABA) receptors to neurotransmitters, GABA, which causes a prolongation of inhibitory chloride ion current after a pulse of GABA release. Postsynaptic neuronal excitability is thus diminished.

# Inhalation anesthesia

- Other receptors are also effected for example, the activity of the inhibitory glycine receptors in the spinal motor neurons are increased.
- In addition, inhalation anesthesia block excitatory postsynaptic current of the nicotinic receptors.

# Halothane

- Is the prototype to which the newer inhalation anesthetics have been compared.
- It has the ability to induce anesthetic state rapidly and to allow quick recovery.
- However, with the recognition of serious side effect and the availability of other anesthetics that have less complication, halothane is largely being replaced.
- Halothane is potent anesthetic, nonetheless it is relatively weak analgesic. Thus, it is co-administered with Nitrous oxide, Opioids.

# Halothane

- Halothane produce bronchial smooth muscle relaxation, which make it beneficial for patients with asthma.
- Is not hepatotoxic in pediatric patients, and it has a pleasant odor, which make it suitable in children for inhalation induction.
- Halothane is metabolized in the body to tissue toxic materials, which may be responsible for the toxic reaction that some patients (specially females) developed after anesthetic.
- The reaction begin as a fever followed by anorexia, vomiting, and patient may exhibits signs of hepatitis.

# Halothane

- Adverse effect: halothane causes bradycardia. It has undesirable property of causing cardiac arrhythmias.
- Halothane produces concentration dependent hypotension. It is recommended that a direct vasoconstrictor such as phenylephrine, be given.
- In a very small percentage of patients halothane has the potential to induce malignant hyperthermia.

# Enflurane

- Is less potent than halothane, but produce rapid induction and recovery.
- About 2 % is metabolized to fluoride ion, which is excreted by the kidney, therefore Enflurane is contraindicated in kidney failure patient.
- Enflurane exhibit the following differences from halothane:
  - (1) Fewer arrhythmia, (2) less sensitizing the heart to catecholamines, and (3) greater potentiation of muscle relaxants due to more “curare-like” effect.
- Disadvantage of Enflurane is that it does cause central nervous system excitation, and so is contraindicated in patients with seizure disorder.

# Isoflurane

- Is widely used, and little metabolized to fluorine, thus it is not tissue toxic.
- It dilates the coronary artery and so may be beneficial for patient with ischemic heart disease.
- Does not induce cardiac arrhythmias and does not sensitized the heart to catecholamines.
- It does produce concentration dependent hypotension due to vasodilatation.
- Has been reported to cause hepatitis, but with a much lower percentage than halothane.

# Nitrous oxide

- Is a potent analgesic, but a weak general anesthetic (at 80% cannot produce surgical anesthesia).
- Therefore, it combined with other potent anesthetic agent to obtained a surgical anesthesia
- Is frequently employed at concentration of 30% in combination with oxygen for analgesia, particularly in dental surgery.
- Because of its fast uptake from the alveolar gas, Nitrous oxide produce what is called “second gas effect”, which result from the ability of Nitrous oxide to concentrate the halogenated anesthetics (Halothane, Enflurane, Isoflurane) in the alveoli when they are coadministered,

# Nitrous oxide

- Main disadvantages is that it has a speed movement, which may retard the oxygen uptake during recovery, thus causing diffusion hypoxia.
- It has moderate to no effect on the cardiovascular system and the least hepatotoxic of the inhalation anesthesia.

# Intravenous anesthesia

- Are often used for rapid induction of anesthesia, which is then maintained with appropriate inhalation agent.
- They are rapid induced anesthesia and so must be injected slowly.

# Barbiturates

- Thiopental is a potent but weak analgesics. It is an ultra-short-acting Barbiturate and has high lipid solubility.
- Quickly enter the CNS and depress function, often in less than one minute.
- It produces short duration of action because its concentration in the CNS decreases quickly below that necessary to produce anesthesia.
- Main adverse effects are coughing, chest wall spasm, and bronchospasm (asthmatic patient).

# Propofol and Etomidate

- Propofol Is an intravenous sedative/hypnotic used in the induction and maintenance of anesthesia, supplementary analgesics is required.
- Propofol is widely used and has replaced thiopental as the first choice for anesthesia induction and sedation, because it produces euphoric feeling in the patient and does not cause postanesthetic nausea and vomiting.
  - Mechanism of action not known but may be through GABA
  - Hypotension caused mainly by vasodilatation rather than cardiac depression
  - Non-analgesic
  - Antiemetic
  - Reduces cerebral blood flow
  - Promotes bacterial growth (hence short shelf life of open solution)

# Ketamine

- A short acting, induced anesthetic. It actually induce a dissociated state in which the patient is unconscious but appears to be awake and does not feel pain.
- Provides sedation, amnesia, and immobility.
- It stimulate the central sympathetic outflow, which causes stimulation of the heart and increased blood pressure, and cardiac output.
- This property is specially beneficial in patients with either hypovolemic or cardiogenic shock, as well as in patient with asthma.

# Ketamine

- However, this property limited the use of ketamine in the hypertensive or stroke patients.
- It is not widely used because it increases cerebral blood flow, and induces postoperative hallucination particularly in adults.
- Ketamine is mainly used in children and young adults for short procedure.

# SUMMARY

## Therapeutic Disadvantages of Anesthetic Agents

## Therapeutic Advantages of Anesthetic Agents

### INHALATION ANESTHETICS

Incomplete anesthesia  
No muscle relaxation

Nitrous oxide

Rapid onset & offset  
Good analgesia

Reduced liver & kidney  
blood flow  
Reduced BP  
Sensitizes heart to arrhythmia

Halothane

Pleasant smell  
Good for asthmatics & kids

Respiratory depression  
Seizure activity

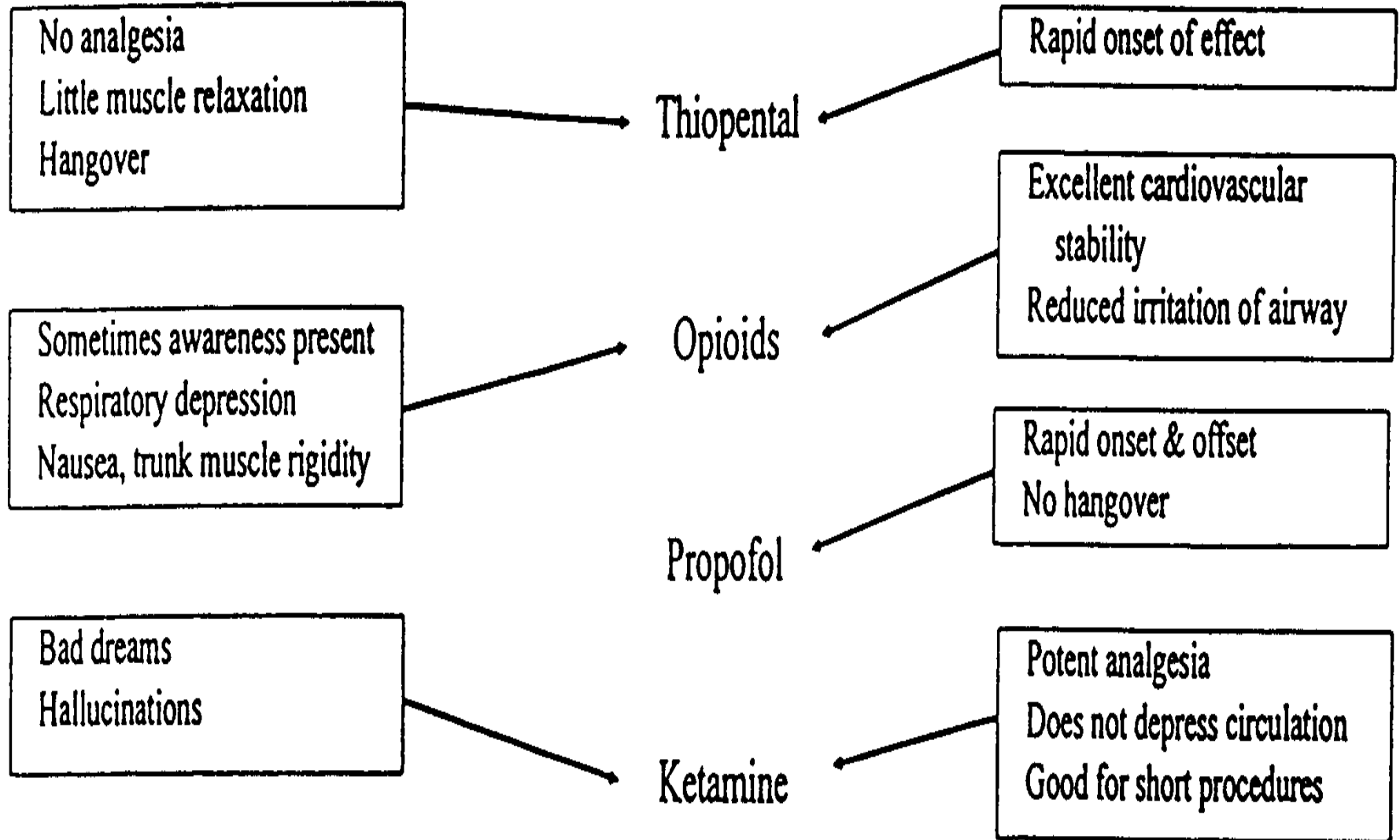
Enflurane

Expensive, irritant

Isoflurane

Good muscle relaxation  
Rapid recovery  
Cardiac output stable  
Does not sensitize heart to  
arrhythmia

# INTRAVENOUS ANESTHETICS



# Local anesthesia

- Local anaesthetics block the initiation and spread of action potentials in nerve fibres by preventing the voltage-dependent increase in  $\text{Na}^+$  conductance.
- They do this in two ways :
  - (1) By acting non-specifically to stabilise the membrane.
  - (2) by specifically plugging  $\text{Na}^+$  channels. The latter mechanism is the most important for most local anaesthesia.
- Most are used with adrenaline to prolong duration of action by constricting blood vessels.

# Topical Agents

- Local anesthesia is applied directly to mucous membranes such as those of the conjunctiva, nose, throat, or urethra.
- Agents of choice is Tetracaine. Patients may complain of a burning sensation. Less so with Proparacaine.
- Onset of anaesthesia takes about 20 seconds and duration of action is about 8 minutes.
- **high concentrations (2–5%).**

# Injection Agents

- The most commonly used agents are : procaine, Lidocaine, Tetracaine and Bupivacaine (lidocaine being the most).
- They vary in their duration of action and time to onset of anaesthesia.
- Infiltration or Local Anaesthesia  
Local anesthesia is injected subcutaneously around sensory nerve endings. Useful in minor surgery.
- ***Infiltration anesthesia* can produce with 0.25–0.5% aqueous solution of lidocaine or procaine (usually with co-administration of adrenaline).**

# Injection Agents

- Intravenous Regional Anaesthesia

Local anesthesia injected intravenously distal to a pressure cuff to arrest blood flow.

Remains effective until the circulation is restored. Used for limb surgery. Mainly Lidocaine (Lignocaine) and Prilocaine.

- Spinal Anaesthesia

Local anaesthesia injected intrathecally into the CSF of the subarachnoid space to act on spinal roots and spinal cord.

Used for surgery to abdomen, pelvis or leg when general anaesthesia not appropriate. Mainly Lidocaine and Tetracaine.

# ***epidural***

- ***anesthesia*** (injection of the Local anesthesia to the spinal column but outside the dura mater), used ***in obstetrics***;