

ANAESTHETICS

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Introduction

Objective:

- ✚ It is to reduce sensory awareness and to suppress reflexes sufficiently to permit the conduct of surgery.
- ✚ Anesthetics are agents which eliminate body sensation.
- ✚ The term anesthesia is now broadly applied in the surgical field to a complex procedure by which the patient is prepared psychologically for the operation and then rendered insensible to all feelings in the operation area, oxygenation of the blood is maintained at optimum levels, pharmacological means are used to keep the field of surgery clear of blood and muscle tone is decreased so that manipulations may be carried out easily and quickly.
- ✚ This procedure involves extensive premedication and the administration of ancillary therapeutics after anesthesia has been induced.

Drugs are used with an aim to:

- i). Reduce the likelihood of shock
- ii). Minimize the amount of anesthetic required
- iii) Reduce salivary and respiratory secretions.

Shock is reduced in two ways:

1) By lowering the blood pressure and preventing the physiological constriction of the peripheral blood vessels. This maintains normal capillary function under conditions which would otherwise result in peripheral vasoconstriction followed by capillary anoxia and an increased vascular permeability-which is the normal reaction to traumatic shock.

The blood volume must be maintained by the injection of blood volume expanders should a state of shock appear imminent.

2). By reducing apprehension and voluntary struggling due to fear.

- ✚ A reduction in the amount of anaesthetic required is achieved by lowering the level of brain activity, and by the use of muscle relaxants.
- ✚ Chloral hydrate, morphine, pethidine, chlorpromazine and xylazine have general sedative effects, and in addition, some have analgesic actions.
- ✚ Muscle relaxants include tubocurarine chloride and succinylcholine, while atropine and scopolamine (hyoscine) have a depressant action on secretions.

There are two main groups of anesthetics:

1).General anesthetics, which besides causing the loss of sensation and the abolition of voluntary motor response also induce sleep, or a level of central nervous system (CNS) depression equivalent to sleep.

2).Local anaesthetics which merely desensitize one area of the body and have no direct effect on the CNS.

A). General Anaesthetics

Classification of General Anaesthetics

1).Non Volatile anaesthetics (Intravenous anaesthetics): These are classified into:

a). Barbiturates. This includes-:

i).Long acting barbiturates e.g. Phenobarbitone; methylphenobarbitone

ii). Medium acting barbiturates e.g. Butobarbitone; pentobarbitone

iii).Short acting barbiturates e.g. Methohexitone sodium; thialbarbitone sodium; thiamylal sodium; thiopentone sodium

b). Non barbiturate, non volatile anaesthetics: This includes-:

i). Chloral hydrate

ii).Ketamine hydrochloride

iii).Alphaxalone (Saffan; Althesin)

iv. Metomidate (Hypnodil)

v). α -chloralose

2). Volatile and gaseous anaesthetics (Inhalational anaesthetics). This includes-:

a). *Volatile anaesthetics*. Examples are:-

- i). Halothane
- ii). Methoxyflurane
- iii). Trichloroethylene
- iv). Enflurane
- v). Chloroform
- vi). Ether

b). *Gaseous anaesthetics*. Examples are:-

- i). Cyclopropane
- ii). Nitrous oxide

✚ An ideal general anesthetic should possess a number of essential characteristics:-

1. It must be easily and painlessly administered
2. It must induce a rapid loss of consciousness without causing voluntary or involuntary struggling
3. It must not cause any excessive drop in blood pressure, depression of respiration or heart action, or increase respiration and salivary secretions
4. It must give adequate analgesia and muscular relaxation at the minimum dosage required to cause loss of consciousness
5. It must be completely non-toxic
6. It must be easily reversed by a non toxic antidote so that the duration of anesthesia can be shortened at will
7. It must have a short recovery period without causing excitement
8. It must be compatible with premedication and other ancillary therapeutics

✚ Each of the general anaesthetics currently available possesses one or more of the attributes of a perfect anesthetic, but none of the available agents meets all of the above criteria.

Control of anesthesia

- ✚ During the induction of anesthesia and recovery from anesthesia, the depth of effect is determined by repeated tests of the animals reflex response to stimuli and the degree of relaxation of appendages such as the tail.
- ✚ During anesthesia, the depth of anesthesia and the circulatory condition are determined by frequent examination of mucous membranes, papillary and other reflexes, rate, depth and regularity of respiration, character and the rate of pulse.

Reflexes in anesthesia

- ✚ The majority of anaesthetics are spoken of as descending anaesthetics, that the reflexes of the head and fore part of the body are eliminated before those of the hind quarters.

- ✚ During induction, reflexes disappear in approximately the following order:-

i)1.a). Ear twitch

b).Jaw and tongue

2. Front [pedal

3. Body reflexes-Scratch and panniculus response

4. Hind pedal

5. Tail relaxation

6. Palpebral

7. Corneal

8. Pupillary

- ✚ The stimuli which initiate these reflexes are: Touch in the case of 1a; 6 and 7; forcibly opening of the mouth in 1b; light in 8; pain in 2, 3, and 4.

- ✚ The jaw reflex is not readily applicable in large animals.

- ✚ Most important are the corneal and papillary reflexes, for these give the final warnings against over dosage.

- ✚ In light anesthesia, the eye lids are open, the corneal response (closure of lids on touching the cornea) is rapid, and the pupil is usually dilated but will frequently respond to light.

- ✚ In deep anesthesia, the pupil is constricted and the lids are closed.
- ✚ In dogs and cats, the corneal reflex may be absent, but in horses, the corneal reflex may persist until death is imminent.
- ✚ Sudden dilation of the pupil is an indication of over dosage; death is imminent if not already a fact.

Control of Oxygenation

- ✚ The state of oxygenation and circulatory well being are normally estimated by examination of the oral and ocular mucous membranes, the [pulse and the respiration.
- ✚ The membranes should be light pink in colour, not dark red or blue; the vessels should not be engorged and pressure on the gum should produce a white mark which disappears within a few seconds.
- ✚ It must be remembered, however, where hypotensive agents such as the hexamethonium salts are used, the blood pressure will be low and mucous membranes recovery will be relatively sluggish.
- ✚ Precautions relevant to oxygenation are intubation, whereby a tube is introduced into the trachea to ensure a clear airflow, premedication with atropine or a similar drug to reduce salivary and respiratory secretions, and positioning the animal with its head lower than the body so that fluid of the gastro-intestinal, salivary or respiratory origin will drain out of the mouth and NOT back into the lungs.

1). Intravenous Anaesthetics (Non Volatile Anaesthetics).

These are mostly water soluble solids which must be given orally or by parenteral injection.

a). Barbiturates

- i). Long acting barbiturates. These comprise phenobarbitone; methyl-phenobarbitone and their sodium salts.

Phenobarbitone (Phenobarbital, U.S.P)

- ✚ It is absorbed slowly and excreted slowly. It causes prolonged CNS sedation, since excretion of a single dose takes several days.

Uses.

1. As an anticonvulsant in the treatment of neurotrophic Virus Syndrome of dogs e.g. Canine distemper

2. In sedation of puppies suffering from convulsions and hysteria associated with teething and the digestive upsets related to teething or other causes.
3. As an anti-epileptic agent in both cats and dogs.

Dosage.

- ✚ The oral dose for dogs is 7.5-15 mg/kg given three times daily (t.i.d). This dosage may occasionally result in accumulation, especially if liver or kidney malfunctions are present. This is indicated by the development of Inco-ordination, with an inability to negotiate furniture or steps.
- ✚ Cessation or reduction of the dosage is usually followed by a return to normal and no other measures are required.

Methylphenobarbitone (mephobarbital, N.F)

- ✚ It may be used instead of phenobarbitone, as its central sedative action is less and its anticonvulsant action is superior. Dosage is the same.

ii). Medium acting barbiturates

- ✚ These sedative hypnotics are exemplified by butobarbitone and pentobarbitone sodium (pentobarbital, U.S.P)

Butobarbitone (Butabarbital, N.F)

- ✚ It is a slightly more effective central sedative than phenobarbitone but its anticonvulsant action is weaker.
- ✚ The indications and dosages are similar to those for phenobarbitone. It has the advantage of being eliminated in about half the time of phenobarbitone.

Pentobarbitone sodium (Pentobarbital, U.S.P)

- ✚ It is whitish, bitter tasting and water soluble.
- ✚ It is reasonably quickly absorbed when given by all but the subcutaneous route and can be used to induce all stages of cerebral and spinal depression.
- ✚ The degree of effect is related to the route of administration and the dosage.
- ✚ The major use of pentobarbitone in the veterinary field is as a surgical anesthetic.

- ✚ It may however, be used as an antidote to eliminate the tonic spasms associated with strychnine poisoning for which purpose, more than the normal anesthetic dose may be required.
- ✚ It is also widely used for euthanasia of dogs and cats, being injected i.v or intraperitoneally as an aqueous-alcohol-glycol-solution containing 195 mg per ml: the dose used varies but is approximately 0.7 ml per kg of body weight, given intravenously.

Dosage.

- ✚ Dosage by intravenous injection to give anaesthesia is 20-35 mg/kg. In general, large animals require about 15 mg/kg bdw.
- ✚ Doses given rally for sedative purposes are much the same as those of other barbiturates.
- ✚ Doses injected i.m for sedative purposes should be about half those given for anaesthesia.
- ✚ Pentobarbitone sodium is commercially available as stable solutions containing 65 mg per ml for anaesthetic purposes and 195 mg per ml for euthanasia and large animal anaesthesia. Capsules are also available.

iii). Short acting barbiturates.

- ✚ These include methohexitone, thiamylal sodium, thialbarbitone and thiopentone. Of these agents , thiopentone is used most frequently.

Thiopentone sodium (Thiopental sodium, U.S.P)

- ✚ It is a yellow, unstable water soluble salt. When made up with water for injectiobn, the solution should normally be used within a few hours, since hydrolysis occurs fairly rapidly: no solution should be used after three days at room temperature.
- ✚ Thiopentone can only be used as an intravenous injection for the induction and maintenance of anesthesia.
- ✚ It may be used with or without prior sedation and analgesia (with chlorpromazine, morphine or pethidine), and may also be combined with muscle relaxants.
- ✚ The most frequent consequence of overdosage with short acting barbiturates is temporary apnoea (15-60 seconds duration) due to transient depression of the respiratory centre.

- ✚ Laryngospasms or bronchospasms are sometimes seen and can be fatal in the absence of determined intervention by intubation.
- ✚ By varying the methods of injection, thiopentone sodium can be used for operations and manipulations of short duration, such as x-ray procedures, dental surgery, minor surgery and abdominal palpation.
- ✚ It is widely used in small animal practice and premedication with a phenothiazine tranquillizer is a routine adjunct.
- ✚ This reduces the amount of thiopentone necessary for induction and so reduces the toxic hazard.
- ✚ Additionally, the recovery period is then relatively free from the convulsive struggling which frequently accompanies barbiturate anaesthesia.
- ✚ It is pharmacologically interesting to note that while clinical recovery from thiopentone anaesthesia depends on the transfer of the drug in to less vascular tissues, this sequestered anaesthetic is still potentially biologically active.
- ✚ Its elimination is effected over a period of days by the usual processes of metabolism and excretion, very little is excreted unchanged.
- ✚ When using thiopentone, it is important to ensure that none of the solution is injected into the peri-venous tissues.
- ✚ However, should peri-venous leakage occur, it is important to inject large volumes (0.5 litres) of saline containing hyaluronidase as soon as possible.
- ✚ This precaution will significantly reduce the tissue reaction to the barbiturate and will eliminate the possibility of skin sloughing.

Dosage.

Large animals: 10 mg/kg

Small animals: 20-35 mg/kg to effect.

- ✚ Thiopentone sodium is available commercially in 0.25g; 0.5g and 1 g ampoules.

b). Non barbiturate, non volatile anesthetics.

i). Chloral hydrate.

- ✚ The systemic effect of chloral hydrate is CNS depression, affecting the motor impulses of the brain and spinal cord.
- ✚ The local effect is irritation., whether the drug is given by mouth, applied externally in liniments or in advertently injected extra-vascularly.

Uses.

- ✚ Chloral hydrate is used mainly in the horse for:

1. A light sedative action, as in the treatment of colic
2. A basal narcotic effect, prior to anesthesia with volatile or local anaesthetics
3. General anesthesia by intravenous injection; either alone, with magnesium sulphate and pentobarbitone sodium, although these mixtures are not currently in common use.

- ✚ Chloral hydrate should not be used during caesarian section, for it passes the placental barrier and depresses foetal respiration.
- ✚ Excretion is via the kidneys in the form of urochloralic acid, which is formed in the liver by the conjugation of chloral hydrate with glucuronic acid, very little is excreted unchanged.
- ✚ Whether orally administered or injected intravenously or intraperitoneally, chloral hydrate should be well diluted in order to avoid irritation.

Dosage and administration.

- ✚ The oral dose for sedation is 15-45 g for the horse and cow; 2-4g for the sheep and pig.
- ✚ When chloral hydrate is administered intravenously, the dose for anaesthesia with farm animals is: 0.3-0.4g per kg.
- ✚ The dose for narcosis is 0.15-0.2 (for light narcosis); 0.2-0.3 (medium narcosis) or 0.25-0.35 (or deep narcosis) mg/kg.
- ✚ In all cases, the dose should be judged according to effect.

Toxicity.

- ✚ Chloral hydrate anesthesia has a narrow safety margin. Existing heart or kidney disease increases the anaesthetic risk and even without over-dosage, death from respiratory failure or occasionally circulatory collapse can occur.

Combinations with chloral hydrate

- ✚ Various combinations of chloral hydrate with magnesium sulfate and pentobarbitone sodium have been used, with the aim of avoiding excitement during induction and recovery from anesthesia.
- ✚ The most commonly used mixture consists of 21.3g chloral hydrate, 4.8g pentobarbitone and 10.6g magnesium sulphate in 500 ml of an aqueous solution containing propylene glycol and 9.5% alcohol.

Ketamine hydrochloride

- ✚ Ketamine hcl was introduced as an anesthetic for cats and is currently used in a wide variety of animals.
- ✚ In man, it produces a state of dissociative anaesthesia. In this state, analgesia and amnesia are pronounced, but muscle relaxation is poor and the patient remains capable of responding to instructions.
- ✚ Respiratory function is little altered, but there is some increase in heart rate and blood pressure, and also of the brain activation of central sympathetic centres.
- ✚ Salivation occurs, but is not a problem since swallowing is not impaired.
- ✚ Dosage for cats is: 44mg per kg i.m, with a maximum of 50 mg per kg for extended periods of narcosis.
- ✚ The duration of anesthesia is 30-45 min: Increasing the dosage tends to increase the duration of effect rather than intensity.
- ✚ Intravenous injection of 5-10 mg per kg is also satisfactory for small animals. Atropine may be used to control unwanted secretions.
- ✚ The ease of administration of Ketamine and a wide safety margin makes it attractive for routine minor use.
- ✚ Return to full consciousness occurs slowly over a period of several hours, making the drug more suitable for inpatient use in small animals.

Alphaxalone (Saffan, Althesin)

- ✚ It is an anesthetic steroid of high potency which induces rapid anesthesia and has a low order of irritation and a wide safety margin. The compound lacks significant hormonal activity.

- ✚ Its low water solubility is increased 100 fold by a surfactant, and by a further factor of three by the related anesthetic steroid alphadolone acetate.
- ✚ Unfortunately, the surfactant is a potent histamine releasing agent in the dog and the product is therefore contraindicated in these species.
- ✚ Alphaxalone is unsuitable for horses as it causes excessive excitement.

Toxicology

- ✚ In the cat, edematous reactions have been recorded due to pulmonary complications.

Actions.

- ✚ Unconsciousness is accompanied by good muscle relaxation.
- ✚ Recovery is rapid and the animal appetite is restored.
- ✚ Following i.v. injection, there is a 20-30% fall in arterial blood pressure, followed five minutes later by an increase to a level of approximately 10% above normal.
- ✚ Respiratory depression is not a problem in cats.

Metabolism

- ✚ Narcosis is terminated by hepatic metabolism, the breakdown products being excreted in the bile.

Dosage

Cats: 9mg/kg (i.v) and 12 mg/kg (i.m)

Primates: 6-9 mg/kg (i.v) and 12-18 mg/kg (i.m).

Rabbits: 6-9 mg/kg (i.v).

Birds: 12-14 mg/kg (i.v).

Metomidate (Hypnodil)

- ✚ Metomidate (3.5 mg/kg i.v) has been evaluated for the induction of brief anesthesia in horses premedicated with azaperone and appears capable of inducing anesthesia as rapidly as thiopentone but without some of thiopentones hazards e.g. apnoea; tachycardia and fall in cardiac output).
- ✚ Recovery from anaesthesia is sometimes abrupt and accompanied by motor excitement.

- ✚ Unfortunately, metomidate causes hemolysis which increases with the rate of intravenous infusion, and this is not an acceptable side effect.

α -Chloralose

- ✚ It has anesthetic properties which are not, however suitable for clinical exploitation as the injection volume is large, induction is slow, anesthesia is shallow, duration is long and recovery is slow.
- ✚ The material is, however, used in the control of rats and pigeons since it causes poisoning characterized by CNS depression and hypothermia.

2). Inhalational Anaesthetics (Volatile and Gaseous anaesthetics)

a). Volatile anaesthetics.

Halothane (Fluothane)

- ✚ Halothane is a potent anaesthetic capable of maintaining anaesthesia effectively in large animals.
- ✚ Its principal dis-advantage is the marked depression it produces in cardio-pulmonary function.

Uses.

- ✚ Induction requires a concentration of 2-4%, while 0.5%-2% is sufficient for maintenance purposes.
- ✚ Halothane is capable of inducing anesthesia rapidly in all the domesticated species and is about twice as safe as ether or chloroform.
- ✚ Recovery is rapid and uneventful.
- ✚ In large animal practice, halothane is more frequently used as a maintenance anaesthetic.

Dosage.

Horses (Body weight approximately 450 kg)

Induction: 30-40 ml.

Maintenance: 35-40 ml.

Cattle (Body weight approximately 450 kg)

Induction: 30-40 ml.

Maintenance; 30 ml.

Sheep and goats.

Induction: 2-4%

Maintenance: 1.5-2%

Dogs and cats.

Induction: 2-4%

Maintenance: 1-2%.

Toxicity.

- ✚ A degree of respiratory depression and some lowering of blood pressure are usual while deep anesthesia carries the risk of circulatory crisis.
- ✚ Liver damage occurs but rarely, and halothane can induce malignant hyperthermia in susceptible swine and human subjects.
- ✚ Shivering on recovery is a frequent side effect.

b). Gaseous anaesthetics

Cyclopropane.

- ✚ It is a safe, powerful, non irritant gaseous anesthetic. Induction and recovery are rapid.
- ✚ Normally, there is little effect on respiration and the anesthetic has been preferred for thoracic surgery.
- ✚ Cardiac irregularities occur, and adrenaline and conditions which are conducive for adrenaline production are contra-indications to the use of cyclopropane.
- ✚ Liver and kidney toxicity is rare.
- ✚ It is administered as a 20% mixture in oxygen, preferably by way of an endotracheal tube.

Dis-advantages

1. Poor muscle relaxation

2. Post recovery vomiting
3. A tendency for increased superficial bleeding due to vasodilatation.

Nitrous oxide.

Actions and Uses.

- ✚ Concentrations of nitrous oxide necessary to achieve anesthesia are so high that adequate oxygenation is not possible.
- ✚ The place of nitrous oxide in veterinary anesthesia is therefore as a maintenance anesthetic following thiopentone sodium induction or as a diluent for halothane-oxygen anesthesia.
- ✚ The amount of oxygen used with nitrous oxide should never fall below 20%.
- ✚ Analgesia is very good with nitrous oxide but muscle relaxation is not marked, and local anaesthetics or muscle relaxants may be used.
- ✚ Induction and recovery are rapid.

Toxicity.

- ✚ Toxicity is almost nonexistent and any difficulties are usually associated with lack of oxygenation rather than anesthetic reactions.

LOCAL ANAESTHETICS.

- ✚ Local anaesthetics are drugs which reversibly block nerve conduction beyond the point of application, when applied locally in an appropriate concentration. Thus, local anaesthesia is a drug induced reversible blockade of nerve impulses in a restricted region of the body.

Classification.

- ✚ Local anaesthetics may be classified according to their chemical structure or their clinical usage.

1. Classification based on their chemical structure:

a). *Esters of benzoic or Amino benzoic acid.* Esters are mostly hydrolyzed by plasma cholinesterase (pseudo cholinesterase). Examples are:-

- i). Benoxinate (Fluress)

- ii).Butamben (Butesin)
- iii).Chloroprocaine (Nesacaine)
- iv). Cocaine
- v).Cyclomethicaine (Surfacaine)
- vi). Dyclonine (Dyclone)
- vii).Ethyl aminobenzoate (Benzocaine)
- viii).Procaine (Novocaine)
- ix).Proparacaine (Aktaine)
- x).Tetracaine (Pontocaine).

b). Amides.

🚩 Amides are largely metablozed in the liver. Examples are -:

- i). Bupivacaine (Marcaine)
- ii).Dibucaine (Nupercaine)
- iii).Etidocaine (Duranest)
- iv).Lidocaine (Xylocaine)
- v).Mepivacaine (carbocaine)
- vi).Prilocaine (Citanest)

c). Ether.

🚩 An example of ether is Pramoxine (Prax).

2. **Based on their clinical usage:** local anaeshetics are classified into the following types:

- a). Topical anaesthetics e.g. benzocaine; butacaine; butyl aminobenzoate; cocaine; benoxinate;; dibucaine; hexylcaine; lidocaine; tetracaine; benzyl alcohol and ethyl chloride.

b). Infiltration and block anaesthetics e.g. procaine; chlorprocaine; hexylcaine; lidocaine; bupivacaine; mepivacaine; piperocaine; tetracaine. In dentistry, butethamine. Metabutethamine and isobucaine may be used.

c). Spinal anaesthetics e.g. tetracaine; procaine; dibucaine; lidocaine; mepivacaine; piperocaine

d). Epidural and caudal anaesthetics. E.g. lidocaine; prilocaine; mapivacaine; procaine; piperocaine; tetracaine.

Absorption of local anaesthetics.

- ✚ Recovery from local anesthesia occurs when the local concentration of the drug falls, following its absorption from its site of administration and action.
- ✚ It is at this time that these drugs may produce their toxic effects if the rate of absorption is fast enough to exceed the rate of biotransformation by such an extent that the concentration of the anesthetic in plasma rises dangerously.
- ✚ Local anaesthetics are not absorbed through intact skin but can pass through abraded areas.
- ✚ The more potent agents e.g. cocaine or cinchocaine formulated as drops or as an ointment, are well enough absorbed to produce anesthesia of mucous membranes.
- ✚ The safety of local anaesthetics, which are not themselves vasoconstrictors, is improved by the inclusion of adrenaline in the injection solution-which diminishes the rate of absorption of the local anesthetic.
- ✚ This device also extends the duration of local analgesia, but the production of local ischemia may delay healing and even cause local tissue damage, especially if concentrations of adrenaline in excess of 1: 50,000 are used.
- ✚ Hyaluronidase can be incorporated in local anesthetic injectables to improve the rate of diffusion of the drug through the subcutaneous tissues.
- ✚ Its action is to reduce the resistance to diffusion by diminishing viscosity.
- ✚ It does not improve the rate of entry of the anesthetic into nerve trunks, but by distributing a given dose over a larger area, does increase its rate of absorption in the absence of a vasoconstrictor.
- ✚ The inclusion of 150-300 units of hyaluronidase per 100 ml of anesthetic approximately doubles the area of anesthesia achieved by subcutaneous injection.

Metabolism of local anaesthetics

- ✚ The liver is the major site of inactivation of local anaesthetics, by esterase's, amidases and conjugation reactions.
- ✚ The safer local anaesthetics are esters whose plasma half life is short e.g. procaine is hydrolyzed by a plasma esterase as well as undergoing hepatic degradation.
- ✚ Some local anaesthetics are amides e.g. lidocaine and undergo the slower hepatic inactivation only.

Toxicity of local anaesthetics.

- ✚ The most dramatic manifestations of toxicity occur following accidental intravenous injection of local anaesthetics.
- ✚ Adrenaline content of some formulations is also a contributing factor.
- ✚ Toxic signs are derived from the involvement of the CNS and the cardiovascular system.

a). Central nervous system effects

- ✚ CNS stimulation include: tremors; restlessness and convulsions, which can be followed by central depression and death due to respiratory failure.
- ✚ Antidotal measures include: a short acting barbiturate or diazepam to control the convulsions, and the provision of oxygen or artificial respiration in the event of respiratory depression.

b). Cardiovascular system.

- ✚ The myocardium is the second site of local anesthetic toxicity. The toxic action involves the membrane stabilizing action of the drugs on the membrane of the myocardium; in which myocardial excitability and force of contraction are reduced (i.e. local anaesthetics have a negative inotropic and chronotropic effects).
- ✚ Myocardial depression is of greater duration among the amide anaesthetics e.g. lidocaine (lignocaine or xylocaine), than it is for procaine.
- ✚ The fall in blood pressure so induced is exacerbated by the ability of most local anaesthetics to cause dilatation of the arterioles due to blockade of sympathetic vasoconstrictor fibers.

c). Local anaesthetics can induce hypersensitivity reactions.

- ✚ While these can be expressed as life threatening anaphylactic reactions, skin sensitization from local application is also possible.