Veterinary Anesthesia

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Abbreviations

mg	Milligram	Kg	kilogram	mL	milliliter
IM	intramuscular	IV	intravenous	S/c	subcutaneous
hrs	Hours	ug	microgram	Br	Breathing Rate
HR	Hart Rate	Dy	day	Sec	second
APR	Abdominoperineal resection	ETV	Endoscopic third ventriculostomy		
IPPV	Intermittent positive-pressure ventilation			OD	Overdose

Glossary

- Sepsis means presence of the pathogenic microorganism in the living tissue or in the body fluid
- Contamination the presence of microorganisms on the living tissues, materials and equipment
- Infections the growth of microorganism on, and their invasion of living tissues
- Sterilization means complete elimination of all microorganisms (including both vegetative and spore forming) by using physical and chemical methods of sterilization **.**
- Asepsis is the state of being free from disease pathogenic microorganisms in the living tissue or in the body fluid (such as bacteria, viruses, fungi, parasites) **.**
- Antisepsis is the methods to combat pathogenic microorganisms or inhibit their growth by antiseptics and disinfectants**.**
- Contamination is the presence of microorganisms on the living tissue, materials and equipments**.**
- Infection is the growth of microorganism on and their invasion of living tissues.

Scope

This guideline outlines the basics of general surgery, suture materials and techniques. In order to perform surgery in animals, it is important to know and understand the different techniques of anesthesia and correctly diagnose, construct surgical plan and follow up treatment using diagnostic imaging. So, complete understanding the different anesthetic drugs and techniques as well as the different methods of diagnostic imaging for all animal species is essential and must be achieved.Also know and understand the surgical problems of the different body systems including digestive, respiratory, cardiovascular, urogenital and abdominal wall. Moreover, to accustom

students how to pick the principles up, to recognize case appraisal, etiology, clinical signs, diagnosis and differential diagnosis, prognosis and different traits used of treatment.understand and diagnose lameness in different animal species. Moreover, to accustom students how to pick the principles up, to recognize case appraisal, etiology, clinical signs, diagnosis and differential diagnosis, prognosis and different traits of eye, ear as well as back diseases

1- VETERINARY ANESTHESIOLOGY

– **Definition:**

Anaesthesia means insensibility. It is the name given to the whole art and science relating to the production of insensibility.

It is a reversible process to produce a convenient, safe, effective, yet inexpensive means of chemical restraint so that medical or surgical procedures may be expedited with minimal stress, pain, discomfort, and toxic side effects to the patient or to the anaesthetist.

- ***Criteria for selection of drugs and techniques of anaesthesia***

The choice of the anaesthetic agent or technique depends on several variables:

1) Facilities and anaesthetic equipment available.

2) Personal knowledge and experience.

3) Safety of the anaesthetic agents and cost.

4) The species of animal involved:

a- Size of the animal

b- Demeanor (Temperament).

c- Anatomical and physiological peculiarities.

5) Nature of the operation to be performed:

Magnitude, site and duration of the operation.

6) Physical status of the animal.

Peripheral Anaesthesia

Local and Regional Anaesthesia

Local anesthesia

Local anaesthetics / analgesics

Loss of sensation in a defined body area without loss of consciousness.

These are substances having selective and transient paralytic action on the sensory nerves and

Anaesthetic agent	Trade name	Uses	Potency ratio
1- Procaine Hcl	Novacaine	1-4%	1:1
2- Amethocaine Hcl	Pantocaine	1-2%	5:1
3- Lignocaine Hcl (Lidocaine)	Xylocaine	1-2% 2-4% topically	2:1
4- Mepivacaine	Carbocaine		2.5:1
5- Bupivacaine	Marcaine	0.5-1.0%	8:1
6- Dibucaine	Nupercaine	0.5%	20.0

nerve endings and are used for inducing both local and regional anaesthesia.

Vasoconstrictor + local anaesthetic

- increase duration almost 5 times.

Hyaluronidase + local anaesthetic

- doubles the anaesthetized area.
- Potentiation of local anaesthetics:

Toxic effect of local anaesthetics:

- Drowsiness, twitching and convulsions.
- Respiratory depression, bradycardia and hypotension.

Local Anaesthesia by surface application (Topical)

1- Intended line infiltration

2- Field block

	Onset	Duration
Lidocaine	10-15 min	1-2 h
Mepivacaine	5-10 min	2-2.5 h
Bupivacaine	15-20 min	2.5-6 h

Ropivacaine 5-15 min 2.5-4 h

Local anesthetic – how do they work?

- Diffusion into the nerve
- Sodium channel blockers
- Lipid solubility – potency
- Concentration – onset time and block intensity
- Protein Binding – duration of action

Adverse effects

- Local site reaction
- Central nervous system
- Cardiovascular system
- Nerve injury
  - Needle induced
  - Drug induced
- Allergic reaction – methylparaben
- Methemoglobinemia

The principal advantages of field block are:

a- Absence of distortion of the anatomical features in the line of incision.

b- Ischemia of the tissues within the blocked area if a vasoconstrictor is incorporated in the solution of local analgesic.

c- Muscle relaxation.

d- Absence of interference with the healing of the wound which often claimed to be the chief objection to direct local infiltration analgesia.

Topical application

- Ophthalmic – proparacaine
- Laryngeal – lidocaine
- Topical – prilocaine + lidocaine

CNS Toxicity

- Large blood vessels (epidural)
- CNS toxicity symptoms usually occur before cardiovascular toxicity

- Seizure activity - diazepam + oxygen

Toxic dosage

- Lidocaine 10 to 20 mg/kg
- Bupivacaine 2 to 3 mg/kg

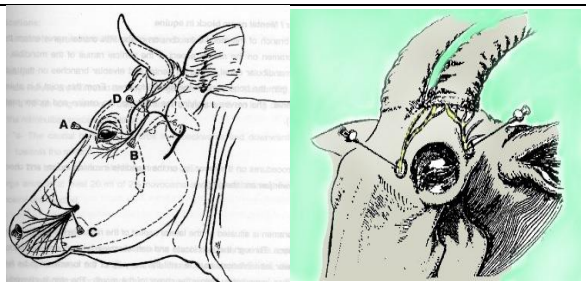
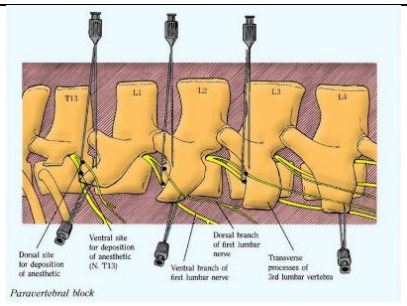
- USE ½ OR LESS THAN TOXIC DOSAGE -

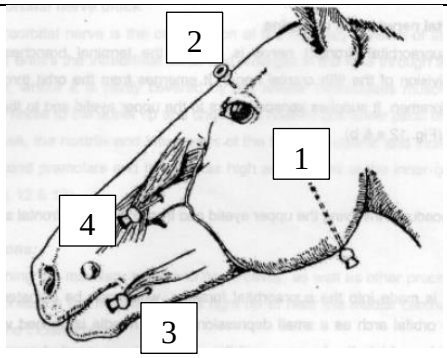
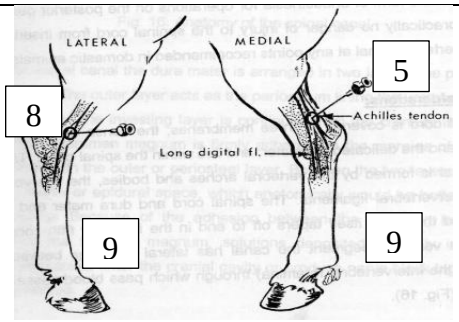
- Cats are more sensitive than dogs
- Birds are more sensitive than cats

REGIONAL ANAESTHESIA

It is loss of sensation in a region of the body. It is affected by blocking the conduction in the sensory nerve or nerves innervating the region where an operation is to be performed

Perineural injections commonly used in veterinary practice including :

1- Cornual nerve block (cattle, sheep and goat).	
2- Ophthalmic nerve block (cattle)	
3- Paravertebral nerve block (cattle).	 *Paravertebral block*

1-Infraorbital nerve block (equine). **2-Supraorbital nerve block (equine)** **3-Mandibular / Mental nerve block (equine)** **4-Auriculopalpebral nerve block (equine)**	
5- Median nerve block (equine) **6-Ulnar nerve block (equine)** **7-Perineal nerve block (equine)** **8-Tibial nerve block (equine)** **9-Palmar/plantar nerve block (equine).**	 **Hind limb**

Equine - Limb regional anesthesia

Epidural ■

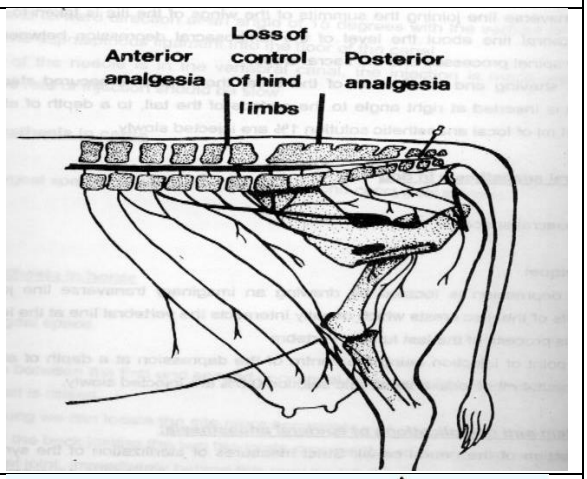
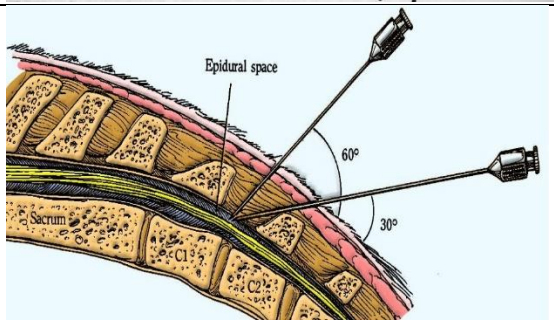
- Brachial Plexus Block
- Ring block
- Paw block

Classification of epidural anaesthesia

1) ***According to the site of injection:***

a- Lumbar epidural anaesthesia: Injection is made in lumbo-sacral space and is indicated for small animals.

b- Caudal epidural anaesthesia: It is indicated for large animals and the injection is made either in the sacrococcygeal space such in buffaloes (with perpendicular angle), or in the first intercoccygeal space such as in cattle (perpendicular angle), camel (perpendicular angle) (perpendicular angle), horses (with angle 60 °), and donkeys (with angle 30 °) .

Species	Site of injection	Angle of needle insertion	
Cattle	first intercoccygeal space	perpendicular angle	
Buffalo	sacrococcygeal space	perpendicular angle	
Sheep and Goat	Lumbosacral space	perpendicular angle	
Camel	first intercoccygeal space	perpendicular angle	
Horse	first intercoccygeal space	angle 60 °	
Donkey	first intercoccygeal space	angle 30 °	
Dogs	Lumbosacral space	perpendicular angle	

2) According to the distance forwards the anaesthetic solution spreads in the spinal canal, and thus the extent of the area in which the sensory and motor paralysis subsequently develop, into:

a- Posterior type:

b- Anterior type

Use epidural for:

- Caudal surgery
  - Tail amputation
  - Perianal surgery
  - Rear limb surgeries
- Abdominal surgery
  - Cesarian section
- Urogenital surgery

- Thoracic surgery (neuraxial analgesia)

Do not use epidural if:

- Absolute
  - Systemic or local infection
  - Blood withdraw
  - Allergies (local anesthetics or opioids) .
  - Coagulopathies
- Relative
  - Hemodynamically unstable
  - Pelvic fracture

Confirmation of succus injection

- Loss of resistance
  - Air or saline
  - Hanging drop
  - Bubble compression
- Nerve irritation
- Radiography
- Anal relaxation
- Blood, CSF

Adverse effects

- Hypotension
- Hypoventilation
- Pruritus
- Sedation

Complications

- Dural puncture – subarachnoid injection
- Venous puncture
- Retention of urine
- Infection

- Neurological sequelae

Epidural

- Drug protocol
  - Bupivacaine (5mg/ml) use 0.2ml/kg
  - Morphine preservative free 0.1mg/kg
  - Total volume 0.2 ml/kg
- The injection under Sterile procedure
  - Clipping, scrub, surgical gloves
  - Spinal needle – 22G; 1.5" or 2.5"

Site of injection

Epidural anaesthesia in buffalo

Sacrococcygeal space

Epidural anaesthesia in cattle

First intercoccygeal space (between the first and second coccygeal spines).

Epidural anaesthesia in horse

First intercoccygeal space.

Epidural anaesthesia in sheep and goat

Lumbosacral space.

Epidural anaesthesia in Dog

Lumbosacral space

Brachial Plexus Block

Intravenous Regional Anaesthesia

1-Head regional anesthesia

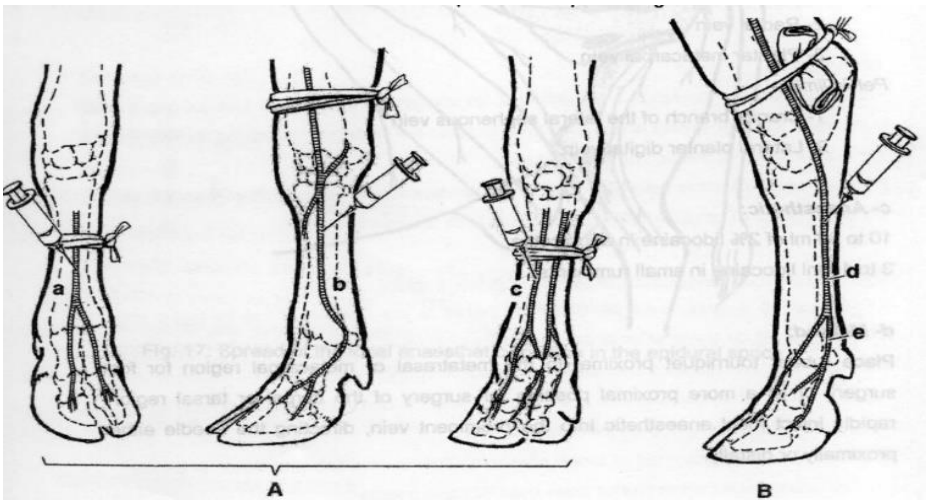
- **Upper lip and nose**
  Lower lip block
  Mental nerve block

Mandibular nerve block

Cheek teeth, canine, incisors, skin and mucosa of the chin and lower lip.

Interpleural nerve block

2-Lower limb regional anesthesia for declaw



A: Fore limb (a: medial digital vein, b: lateral palmar vein, c: dorsal branch of proximal palmar vein)

B: Hind limb (d: cranial branch of lateral saphenous vein, e: lateral plantar digital vein)

Advantages of regional anesthesia

- Very effective
- Little side effects
- Low cost
- Relatively easy

PREANAESTHETIC MEDICATIONS

Indication of preanaesthtic agents administration:

1- Reduce the amount of the general anaesthetic

2- Prolong the duration of anaesthesia.

3- Calm the patient.

4- Reduce the salivary and bronchial secretions.

5- Reduce gastric and intestinal mobility and prevent vomiting.

6- Smooth recovery.

7- Block the vago-vagal reflex, thus preventing cardiac slowing or arrest (against shock).

8- Together with local and regional analgesia / helps to restrain the patient during operation, i.e. Rumenotomy in cattle.

9- Produce muscular relaxation.

Classification:

A) Anticholinergics (atropine sulfate and scopolamine Hcl) (Parasympatholytics).
B) Atropine sulfate (Anticholinergic, parasympatholytic)
C) Tranquilizers:

Major tranquilizers	Minor tranquilizers
Potent tranquilizers or autonomic suppressants	Less potent tranquilizers or central relaxants
Phenothiazine derivatives	Propanediol derivatives
e.g. chlorpromazine Hcl promazine Hcl Propionyl promazine Acetyl promazine	Mebropamate Benzodiazepines (Diazepam)
Alpha2-adrenoceptor agonists e.g. Xylazine Hcl, Detomedine, Medetomidine, Romifidine	

D) Narcotics:

- Chloral hydrate (large animals)

- Morphine & morphine substitutes (methadone Hcl) → dogs

D) Neuroleptanalgesics (Tranquilizers - Narcotic combination)

- Methadone-acetyl promazine

E) Muscle relaxants

Tranquillizers (Atractic or neuroleptic drugs)

Types, doses and routs of administration of some tranquilizers in different animals

Tranquilizers	Trade name	Animal	Dose	Route of administration
Chlorpromazine Hcl	Largactil®, Neurazine®	Dogs & cats	1-2 mg/kg b.wt.	All routes
		Horse	0.15-0.2 mg /kg b.wt	IV / IM
Promazine Hcl	Sparine®	Dogs & cats	2-5 mg / kg b.wt.	IV
Promazine Hcl	Sparine®	Horse & cattle	1 mg / kg b.wt.	IV
Propionyl promazine	Combelen®	Dogs & cats	1- 3 mg/kg b.wt.	IM
Propionyl promazine	Combelen®	Horse	0.2 mg/kg b.wt.	IM/IV
Acetyl promazine	Acepromazine®	Dogs & cats	1-2 mg/kg b.wt.	IM/IV
Acetyl promazine	Acepromazine®	Horse	0.1-0.2 mg/kg b.wt.	IM/IV
Xylazine Hcl	Rompun®	Buffaloes	0.05-0.15 mg/kg b.wt	IM
Xylazine Hcl	Rompun®	Cattle	0.1-0.3 mg/kg b.wt	IM
Xylazine Hcl	Rompun®	Sheep & goats	0.1-0.3 mg/kg b.wt	IM
Xylazine Hcl	Rompun®	Dogs	0.3-1.0 mg/kg b.wt	IV/IM
Xylazine Hcl	Rompun®	Cats	0.8-2.0 mg/kg b.wt	IM
Xylazine Hcl	Rompun®	horse	1.0-1.1 mg/kg b.wt	IV
Detomedine Medetomidine Romifidine	Demosedan® Domitor® Sedivet®	Horse Cattle Horse	5-80 µg/kg b.wt. 10-30 µg/kg b.wt. 40-80 µg/kg b.wt	IV IV IV

NB. Antidote: Yohimbine® or Atipamezole (Anticidan®) (according to prescription).

Symptoms of toxic doses:

Hypotension, tremors, dyspnea, convulsions, ataxia and death.

Treatment of toxic doses:

Norepinepherine or phenylephrine

Uses

1- Therapeutic uses;

a- As preanaesthetic sedative

b- To relieve anxiety in hospitalized animals.

c- To restrain refractory animals during examination and radiology.

d- To prevent animals from licking wounds or chewing bandages and splints.

e- As an antiemetic for car sickness or prior to administration of anthelmintics.

f- For treatment in tetanus and colic.

2- In transportation or shipment of large animals.

3- For fattening (calming).

(III) Narcosis

A sleep-like state (unconsciousness) accompanied with varying degrees of analgesia (dulls the sense i.e. relieve pain).

Narcotics are used as a preanaesthetic in horse and in dogs.

Narcosis in Horse

- Chloral hydrate

- Increasing narcotic doses produces progressive depression of the cerebrum (mild to deep narcosis).

Narcosis in dogs:

Morphine and morphine substitutes

Dose: 5 mg/kg b.wt. SC

- Contraindicated in dogs suffering from shock, and in cats because it causes maniac state and tonic convulsions ending with death in large doses.

(∇) Muscle relaxants

Classification of muscle relaxants:

1) Depolarizing agents:

- Succinylcholine (IV 4 mg/50 kg b.wt. for horse)

Disadvantages:

- Relaxation of intercostal muscle leading to asphyxia.

- Decamethonium (safe in pregnant animals)

2) Non-depolarizing agents:

- d-Tubocurarine chloride (2 mg/10 kg b.wt. for small and large animals)

- Gallamine (Flaxidil®) 1 mg/kg b.wt.

3) Dual blocking agents:

- Hexabischarbacholine

4) Miscellaneous group (central):

- Mephenesin

-Glyceryl guaicolate (Guaifenesin®): Commonly used in equine in a dose of 50 mg/kg 5% solution.

- Diazepam

Other muscle relaxant agents:

Magnesium sulfate (peripherally acting) used with chloral hydrate in treatment of tetanus (1 gm/100 kg b.wt.)

(IV) Neuroleptics as Methadone-Promazine

GENERAL ANAESTHESIA

Definition:

It is a state of unconsciousness accompanied with hyporeflexia, analgesia and muscle relaxation. It is produced by administration of drugs having selective and reversible depression of the central nervous system.

Classification:

General anaesthesia is classified according to the rout of administration of the anaesthetic drugs into:

1- Intravenous general anaesthesia

2- Inhalation anaesthesia

3- Combination of intravenous and inhalation anaesthesia i.e. induction with intravenous and maintenance by inhalation.

Intravenous General Anaesthesia

Indications:

1- For induction of anaesthesia

2- As a sole anaesthetic agent for short term minor procedures.

Advantages:

1- Simple

2- Rapid onset

3- Relatively pleasant for animal

4- No apparatus needed

5- No explosion / pollution hazard

6- Non-irritant to airways.

Disadvantages:

1- Superficial vein may be difficult to find.

2- Animal may struggle.

3- Drug may be irritant if given perivascular.

4- Once injected it cannot be removed.

5- Drug may be cumulative

6- If the animal is not intubated, you are not ready for a respiratory emergency

7- Possible apnea on injection.

Intravenous anaesthetic drugs (Classes of drugs):

1-Barbiturates.
a- Thiopentone sodium

b- Methohexitone sodium

c- Pentobarbitone sodium

2- Propofol

3-Dissociative agents

Dogs

- Only licensed for use in combination with xylazine

- Ketamine (10 mg/kg) / Xylazine (1 mg/kg)

- Ketamine (5 mg/kg) / Diazepam (0.1 mg/kg)

Cats:

- Ketamine alone in a dose of 10-20 mg/kg IM

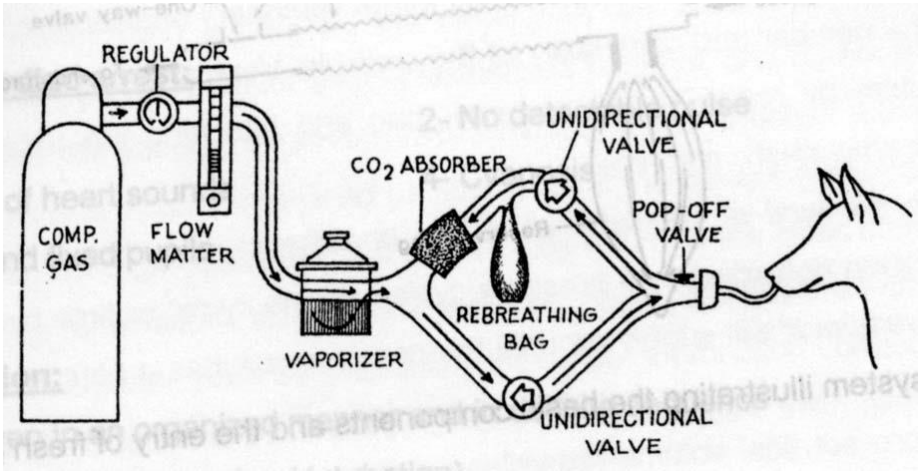
- Ketamine (10 mg/kg IM) / Xylazine (1 mg/kg IM)

- Ketamine (10 mg/kg IM) / Acepromazine (0.1 mg/kg IM)

4- Steroids mixture **Saffan®**

5- Neuroleptanaesthetic mixtures.

INHALATION ANAESTHESIA



Stages and planes of anaesthesia

Stage of anaesthesia	Respiration	Cardiovascular function	Eyeball position	Pupil size	Pupil response to light	Muscular tone	Reflex response
I) Induction	Normal rate in dog (20-30 breath/min.)	Normal	Central	Normal	Yes	Good	All present
II) Excitement	Irregular , may hold breath or hypoventilation	HR may increase	Central may be nystagmus	May be dilated	Yes	Good	All present
III) Plane 1 Light anaesthesia	Regular rate (12-20 breath/min)	HR > 90 beat/min	Central or rotated , may be nystagmus	Normal	Yes	Good	Swallowing poor or absent. Other present but diminished
III) Plane 2 Medium surgical anaesthesia	Regular may be shallow (12-16 breath/min)	HR>90 beat/min	Often rotated ventrally	Slightly dilated	Sluggish	Relaxed	Patellar, palpebral , and corneal may be present others are absent
III) Plane 3 Deep surgical anaesthesia	Shallow rate < 12 breath/ min	HR is 60-90 beat/min, pulse is less stronger	Centrally, may rotate ventrally	Moderately dilated	Very sluggish	Greatly reduced	All reflexes diminished or absent
IV) Toxic stage	Apnea	Cardiovascular collapse	Central	Widely dilated	Unresponsive	Flaccid	No reflex activity

System of Classification of Inhalation Anaesthetic Apparatus

System	**Open**	**Semi-open**	**Semi-closed**	**Closed**
	Mask Open drop Anaesthetic box	- Magill system - Ayre-piece - Norman elbow	- Circle system	Circle system
Reservoir bag	No	Yes	Yes	Yes
Rebreathing	No	No	Partial	Complete
Co2-absorber	No	No	Yes	Yes
Component	-	- Flowmeter - Vaporizer - Reservoir bag - O2 cylinder	- Flowmeter - Vaporizer - Reservoir bag Soda lime canister	- Flowmeter - Vaporizer - Reservoir bag Soda lime canister

Cardiac arrest and Resuscitation

Resuscitation: restoration of life after apparent death

Permanent brain damage is the consequence when brain hypoxia exceeds 4 minutes.

Signs of cardiac arrest:

1- Apnea 2- No detectable pulse

3- Absence of heart sounds 4- Cyanosis

5- Dilated and fixed pupils

Resuscitation:

Must be given in an organized manner and in definite sequence

a- Air way patent (endotracheal intubation)

b- Breathing controlled (8-12 breath/min).

The first action to establish patent airway and controlled breathing 8-12 breath/min

c- Cardiac resuscitation.

Cardiac resuscitation refers to external massage which initially is given at a rate of at least 60 compression/min. A pause after 6 compressions should be made.

d- Drugs.

- An IV catheter must be in place for administration of isotonic fluids at a rate not exceeds 80 ml/kg/hr. During the first few minutes the drip should be rapid.

- Usually the vascular bed is dilated and the added fluid volume is helpful and often essential for cardiac filling.

- Drugs given in the first few minutes are sodium bicarbonate (NaHCO3) (2 mEq/kg) and Calcl2 (10 mg/kg) to treat metabolic acidosis and to increase myocardial contractility.

- Isoproterenal (5-30 µg) , epinephrine (100 µg) or dobutamine (5-10 mg/kg/min) can be given to support ventricular function.

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