



## INTRODUCTION TO VETERINARY ANAESTHESIA

It is a well known fact that without ability to produce anaesthesia surgery would still be last hope option. There has been a tremendous advancement in the field of veterinary anaesthesia within last century which in turn has allowed for tremendous advancements in the fields of medicine and surgery. To keep up with the pace of such advancements it's important to recognize such discoveries. Veterinary medicine is often even more dependent on anesthesia than human medicine because of the uncooperative nature of our patients (e.g. - CT scanning: rarely requires anesthesia in humans; always requires anesthesia in veterinary medicine). In the recent years major emphasis is to establish balanced anaesthetic techniques for the veterinary patients.

### TERMINOLOGY

**Anaesthesia:** The term is derived from a Greek word 'Anaisthaesia' means insensibility. The term was coined by Oliver Wendell Holmes in 1886. It is defined as the loss of sensation of a part of the body or body as whole due to nervous tissue blockade, locally or centrally.

**Veterinary anaesthesia:** It is the study of art and practice of anaesthesia in animals.

**Analgesia:** It is defined as reversible loss of sensibility to pain.

**Akinesia:** It means temporary loss of motor reflexes without any loss of pain reflexes (e.g. AP – Nerve block of eye).

**Anxiety & Fear:** It is an emotional state involving increased arousal and alertness prompted by an unknown or known danger.

**Tranquilization:** A state of behavioral change in which there is reduced anxiety with relaxation, but still awareness of surroundings. Pharmacologically it is mild CNS depression in which the patient is awake but calm and there is no drowsiness. The drugs used to produce tranquillization are called 'tranquillizers' or 'ataractics'. **Examples:** Chlorpromazine, promazine, triflupromazine acepromazine etc.

**Sedation:** A state of mild CNS depression characterized by presence of drowsiness with reduced awareness of surroundings.

**Hypnosis:** It is moderate level of CNS depression producing a state of trance resembling sleep but without loss of pain reflexes. **Examples:** Xylazine, detomidine etc.

**Narcosis:** It is drug induced state of deep sleep due to deep CNS depression, from which the patient may or may not be arousable. There is some degree of loss of sensation.



**General anaesthesia:** Loss of sensation to the entire body. It is defined as a state of drug induced reversible unconsciousness, muscle relaxation, and analgesia due to depression of the CNS.

**Surgical Anaesthesia:** A state of general anaesthesia characterized by complete unconsciousness, muscle relaxation and analgesia in which surgery can be performed painlessly without any struggling on the part of the patient.

**Local anaesthesia/analgesia:** Loss of sensation in a prescribed body area (usually infers blockade of a specific nerve or infiltration of a small area with local anaesthetic, e.g. intercostal nerve block).

**Regional anaesthesia/analgesia:** Loss of sensation in a larger, though limited body area (usually infers blockade of a large nerve or group of nerves with local anaesthetic, e.g. epidural anaesthesia).

**Basal anaesthesia:** A state of light level of anaesthesia produced primarily by using preanaesthetics (tranquillizers, sedatives) which form the base for general anaesthesia to be induced by some general anaesthetic agent.

**Balanced/Mixed Anaesthesia:** the combination of several drugs to provide the anesthesia; each drug used usually provides one component of anesthesia, that is, unconsciousness, muscle relaxation, and analgesia and simultaneously reducing the toxic effects of each drug used (e.g. Atropine-xylazine-ketamine anaesthesia in dogs; Atropine-xylazine-thiopentone anaesthesia in horses).

**Dissociative Anaesthesia:** The state of anaesthesia produced by drugs (e.g. ketamine) that disassociate the thalamocortical and limbic systems, resulting in a cataleptoid state, usually with muscle rigidity.

**Neuroleptanalgesia:** A combination of a neuroleptic agent (tranquilizer/sedative) and an analgesic agent to produce a state of heavy sedation and analgesia (eg - acepromazine + morphine).

**Induction:** It is defined as transition from unconscious state to a state of anaesthesia.

**Maintenance of anaesthesia:** It is the process of supplying sufficient anaesthetic to keep the patient in the required plane of anaesthesia.

**Crash induction:** A state of sleep produced rapidly using ultra short acting barbiturate to facilitate endotracheal intubation.

**Opiate:** It is the drug derived from the opium. e.g. morphine.



**Opioid:** It is a general term used to describe a class of drugs such as morphine, its derivatives and other synthetic agents which are addictive, analgesic and generally produce hypnosis (sometimes excitement).

**Pain:** It is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage normally produced due to the activation of discrete set of receptors called nociceptors.

**Nociceptors:** These are receptors which are found in various body tissues and which respond to stimuli which have the potential to damage tissues.

**Pain detection threshold:** It is the lowest intensity of a stimulus that is perceived as pain or that induces a response. It is always **uniform**.

**Pain tolerance threshold:** It is the highest intensity of a noxious stimulus which can be tolerated voluntarily. It is always **variable**.

**Catalepsy:** A state of diminished responsiveness characterized by a trance-like state and constantly maintained immobility usually with rigidity.

### **Philosophy of anaesthesia**

- Death is a late sign of poor perfusion (patients are not fine one minute, and then dead the next...)
- The five "hypo's" - indicators of poor perfusion & potential complications
  - Hypoxemia
  - Hypoventilation
  - Hypotension
  - Hypovolemia
  - Hypothermia
- In spite of significant advancements in pharmacology & technology, the fundamentals of *good patient monitoring* and *support of organ function* are the keys to minimize anesthetic risk and assure a good outcome
- A 'critical patient' is one you cannot afford to lose

### **CLINICAL ANESTHESIA**

- **Three goals**
  - **Survival of patient**
  - **Do no harm**
  - **Anticipate problems:** Accurately predict complications; promptly recognize complications; quickly correct complications; Avoid complications.



- **Ten fundamentals**

1. Evaluate - history, physical exam, laboratory data
2. Stabilize physiological status - before anesthesia if at all possible!
3. Minimize anesthetic time - plan ahead!
4. Choose the best drugs & doses - based on species, breed, health status, pre-existing complications
5. Evaluate effects of premedication before induction
6. Maintain patent airway, monitor & support ventilation, supplement oxygenation
7. Monitor & support cardiovascular function - fluids, ancillary drugs
8. Monitor & support body temperature - minimize heat loss, provide external heat sources
9. Continue monitoring & support until recovery is complete
10. Adequately treat pain

## **THE ANESTHETIC PERIOD**

The anesthetic period may be divided into the following stages:

### **1. Pre-anesthetic examination:**

The preanaesthetic examination varies as per the species, the procedure, the individual animal and circumstances. It includes the knowledge of the health status of the patient so that appropriate therapeutic treatments can be given and suitable precautions taken. The examination may be a complete physical examination alone, or may include laboratory investigations such as hematology, clinical chemistry, medical imaging and electrocardiography.

### **2. Pre-anesthetic preparation:**

For debilitated animals appropriate stabilization is provided. Animals are taken off food and water as necessary, equipment and drugs are prepared. Premedicants are administered.

### **3. Induction of anesthesia.**

The patient is 'moved' from a state of consciousness to unconsciousness (anesthesia is induced) using injectable or inhalation agent. The animal is intubated.

### **4. Maintenance of Anesthesia.**

It includes prolongation of anaesthesia by administration of anaesthesia using inhalation techniques or for short procedures, injectable agents.



## 5. Recovery from anesthesia.

Supportive therapy and monitoring continues into this period.

- **The anaesthetic period generally involves six steps:**
  1. Evaluation of health status – preanaesthetics, physical exam, review of history, laboratory data, other diagnostics
  2. Provide appropriate equipment, supplies, and personnel - "planning *causes* success"
  3. Premedication - consider for all patients
  4. Induction - transition from conscious to unconscious state
  5. Maintenance - appropriate monitoring & support are essential tasks during maintenance
  6. Recovery - return patient to conscious state - continue support & monitoring until complete.

## THE SIGNS AND STAGES OF GENERAL ANESTHESIA

During induction of general anesthesia the patient goes through certain stages of progressive depression of reflexes and vital functions:

- Analgesia and Amnesia
- Loss of Motor Coordination and loss of consciousness
- Reduction of Protective Reflexes
- Blockage of Afferent Stimuli
- Muscle Relaxation
- Respiratory and Cardiovascular Depression
- Apnea
- Cardiovascular standstill
- Death

The clinical signs observed during anaesthesia can be divided into following stages:

### Stage I

This is the stage of voluntary excitement marked by struggling and breath holding if induction is slow and by inhalation. Respiratory rate and pulse rate are increased and the pupils are dilated. Urination and defecation frequently occur. These are signs of the fear response.

### Stage II

In this stage, loss of consciousness occurs. Ventilation is irregular and involuntary excitement may occur.



### Stage III (The stage of surgical anesthesia)

Ventilation is regular. This stage can be loosely divided into three planes of progressive depression of cardiopulmonary function and responsiveness to stimuli.

In plane one painful stimulus may cause an increase in heart rate, blood pressure and respiratory rate. The palpebral reflex is present, and possibly nystagmus. Lacrimation is not depressed. The cornea is still 'shiny'. In dogs and cats the eyeball is centrally positioned. The pedal reflex is also present. Many diagnostic procedures can be done such as radiography or quick lancing of abscesses.

In plane two, the laryngeal reflexes are lost. There is further depression of the cardiopulmonary system. The eyeball rotates down in cats and dogs under halothane, isoflurane, barbiturate and propofol anesthesia. The eye remains central in horses. The palpebral and pedal reflex is lost, and this plane is adequate for nearly all surgical procedures.

In plane three, respiration becomes more depressed and the breathing pattern becomes diaphragmatic in cats and dogs. Cardiac contractility and blood pressure is further reduced. In cats and dogs the eyeball becomes central and there is no palpebral reflex. Lacrimation also ceases, and the cornea looks dry. **This plane is a warning that the animal is receiving too much anaesthetic and should be 'lightened'.**

### Stage IV (Overdose)

Paralysis of the intercostal respiratory muscles occurs and weak diaphragmatic movements are made. With further deepening these also disappear. The abdomen looks as if it is bulging out and the thorax 'caving' in during inspiration. The pulse becomes weaker. The pupils start to dilate and the cornea looks very dry. If these warning signs go unheeded there is complete paralysis of the medulla of the brain, and cardiopulmonary collapse. If the anaesthetic is withdrawn (inhalation agents) and artificial respiration instituted before profound cardiovascular depression occurs, then recovery is possible. With parental anaesthetic agent overdose, antagonistic agents can be used, but not all parental drugs have antagonists.

## CLINICAL EVALUATION

With modern anesthetic techniques using intravenous agents the above stages can be difficult or impossible to differentiate. A clinical evaluation is made as follows:

1. **Too lightly anaesthetized.** There are signs of excitement, motor activity, or unwanted reflexes, e.g. laryngeal stridor, tachycardia or tachypnea.
2. **Adequately anaesthetized.** The depth of anesthesia required will depend on the surgical procedure. For example, using techniques employing muscle relaxants and analgesic agents (e.g. nitrous oxide, opioids) only a light plane of anesthesia would be



required for a laparotomy, but with halothane or isoflurane alone a deeper plane of anesthesia would be required, with more cardiopulmonary depression.

3. **Too deeply anaesthetized.** Cardiovascular and respiratory systems are dangerously depressed.

## CLASSIFICATION OF ANAESTHESIA

1. LOCAL ANAESTHESIA
2. GENERAL ANAESTHESIA

### 4. **Local anaesthesia:**

It is drug induced selective, transient and paralytic action on sensory nerves and nerve endings leading to desensitization of a particular area. The drugs used are known as local anaesthetics e.g. lignocaine, bupivacaine etc.

Further sub classified as follows:

- **Topical or surface analgesia/anaesthesia:** Superficial analgesia of skin or mucous membrane is achieved by application of different local anaesthetics. For example: Lignocaine jelly, ice and volatile drugs like ethyl chloride etc.
- **Infiltration analgesia:** Intra dermal or sub dermal infiltration of local anaesthetic is done to achieve desensitization.
- **Field block:** Non specific regional analgesia is achieved by infiltration of local anaesthetic e.g. ring block, T block, Inverted L block, Diamond block etc.
- **Regional analgesia/anaesthesia:** Specific regional analgesia is achieved by blocking a specific nerve or group of nerves e.g. cornual nerve block, paralumber block etc. It includes perineural, spinal, limb nerve blocks etc.
- **Retrograde IV regional analgesia:** Desensitization of extremities is done by intravenous administration of local anaesthetic after application of tourniquet.

**TENS:** Transcutaneous Electrical Nerve Stimulation. It is low intensity high frequency electrical stimulation of the skin done using surface electrodes to produce local analgesia.

### 5. **General anaesthesia:**

It is the unconsciousness of a subject with analgesia and muscular relaxation due to controlled, reversible intoxication of the central nervous system using drugs or other means. The effect produced by CNS depression is in irregular descending order as follows:

1. **Cerebral cortex:** Loss of final grade of judgement; loss of memory, intellect and
2. **Basal ganglia:** social restraint. Rarely aggressiveness is seen.
3. **Cerebellum:** There is incoordination and staggering.



4. **Spinal cord:** Loss of spinal cord reflexes.
5. **Medulla oblongata:** Finally depression of vital functions e.g respiratory center, vasomotor center and heart regulatory center.

**General anaesthesia is further sub classified as follows:**

- **Inhalation anaesthesia:** Gaseous or volatile.
- **Intravascular:** IV, Intra arterial, intra cardiac or intra medullary.
- **Intra peritoneal:** In small animals like pups, rabbits and lab animals.
- **Intra thoracic:** In small animals like pups, rabbits and lab animals.
- **Intra muscular or sub cutaneous:** Using ketamine, xylazine etc.
- **Oral:** Using chloral hydrate for sedation.
- **Rectal:** Using chloral hydrate.
- **Electro anaesthesia:** Using 35-40 mA/40 volts AC passing through cerebrum to produce anaesthesia.
- **Hypothermia:** The body temperature is lowered to a point to produce anaesthetic effect.
- **Hypnosis and narcosis:** Mostly used as an adjunct to GA or used in combination with local anaesthesia in large animals.
- **Acupuncture:** Morphine like substances (endorphins or enkephalines) are produced by stimulating acupoints (meridians – areas where large and small afferent nerves converge) to produce the anaesthetic effect due to synaptic inhibition of the dorsal horn of the spinal cord.

**INDICATIONS OF ANAESTHESIA**

1. **Restraining of the animals:** Application of splints/cast; wound care (burns); radiotherapy and for capture, identification and transportation of animals.
2. **Examination/diagnosis purpose:** Ear, eye, nose examination; diagnosis of lameness in equines and large animals; endoscopy/laparoscopy; radiography, CT scanning etc.; catheterization of urethra in animals
3. **Surgery of all kinds.**
4. **Control of convulsions in epilepsy or toxicity.**
5. **Euthanasia**