“There are no safe anesthetic agents; there are no safe anesthetic procedures; there are only safe anesthetists” Robert Smith

Introduction

**Veterinary anesthesia** is anesthesia performed on animals (excluding humans) by a veterinarian.

Anesthesia is used for a wider range of circumstances in animals than in people, due to animals' unwillingness to cooperate with certain diagnostic or therapeutic procedures.

Veterinary anesthesia includes anesthesia of the major species: dogs, cats, horses, cattle, sheep, goats, and pigs, as well as all other animals requiring veterinary care such as birds, pocket pets*, and wildlife.

The art and practice of anesthesia based on general understanding of:-

1- The terms that describe the effects of anesthetic drugs in animals.
2- The pharmacology of anesthetic drugs and their antagonists.
3- The correct methods of anesthetic drugs administration, and
4- Appropriate therapy for anesthetic – related complications or emergencies.

History of animal anesthesia (For reading only)**

Attempts at producing a state of general anesthesia can be traced throughout recorded history in the writings of the ancient Sumerians, Babylonians, Assyrians, Egyptians, Greeks, Romans, Indians, and Chinese.

During the Middle Ages, which correspond roughly to what is sometimes referred to as the Islamic Golden Age, scientists and other scholars made significant advances in science and medicine in the Muslim world and Eastern world, while their European counterparts also made important advances.

- The earliest recorded attempts to induce anesthesia appear to have been performed in humans.
- The ancients used:-
  - Opiates
  - Alcohol
  - Asphyxia
  - And even compression of the carotid arteries to alleviate pain during surgical intervention.

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*Pocket pet is a term used to refer to any small mammal commonly kept as a household pet.

• In 1540, Paracelsus produced Ether and reported it to have a soporific effect on fowl. **Despite this**, no further progress was made until Chemistry was developed and Carbon dioxide and several other gases including Oxygen were discovered.

• In 1800, Sir Humphery Davy suggested that Nitrous Oxide might have anesthetic properties.

• Shortly thereafter, H. H. Hickman (1824) demonstrated that pain associated with surgery in dogs could be alleviated by inhalation of a mixture of Nitrous oxide and Carbon dioxide as a result of Carbon dioxide enhancing the rate and depth of breathing.

• However, recent studies have shown that anesthesia can be induced in 30 to 40 seconds in piglets breathing carbon dioxide (50%) alone in oxygen.

• It was not until 1842 that Ether was used for human anesthesia. Two years later, a dentist, Dr. Horace Wells (1844), discovered the anesthetic properties of Nitrous oxide. Although this finding was neglected for several years, nitrous oxide was reintroduced in man in 1862.

• Dr. C. P. Jackson, a Boston physician, was the first clinician to employ Ether extensively in animals.

• Although chloroform was discovered by Liebig in 1831, it was not until 1847 that it was used for general anesthesia in animals by Flourens and in man Dr. J. Y. Simpson of Edinburgh, Scotland.

• With the introducing of Chloroform, reports began to appear in the veterinary literature of its use in animals.

• Dadd routinely used general anesthesia in animals and was the first in the U.S. to advocate human treatment of animals and the application of scientific principles (i.e. anesthesia) in veterinary practice.

• In 1875, Ore published the first monograph on intravenous anesthesia using Chloral hydrate, three years later, Humbert describe its used in horse.

• Pirogoff attempted rectal anesthesia as early as 1847. This rout was used later in veterinary patients largely for the administration of Chloral hydrate.

• Intraperitoneal injection (I.P) was first used in 1892 in France.

• Thus, the various routes for administration of general anesthetics to animals were established by the end of nineteenth century.

• After the initial isolation of Cocaine by Albert Niemann of Germany in 1860, Anrep, in 1878, suggested the possibility of using Cocaine for local anesthesia.
In 1884, Kohler used Cocaine for local anesthesia of the eye, and Halsted described Cocaine nerve block anesthesia a year later. Its use was popularized in veterinary surgery by Sir Frederick Hobday, an English veterinarian. G. L. Corning is created for inducing Cocaine spinal anesthesia in dog in 18885. From his description, however, it would appear that he probably produced epidural anesthesia.

In 1898, August Bier of Germany produced true spinal anesthesia in animals and then in himself and an assistant.

While local infiltration was popularized by Reculs in 1890, and Scheich in 1892, conduction anesthesia was introduced by Halsted and Hall in New York in 1884. These techniques became more popular with the discovery of local anesthetics less toxic than Cocaine.

With these developments, it was possible for Cuille and Sendrail (1901) of France to induce subarachnoid anesthesia in horses, cattle, and dogs.

While Cathelin (1901) reported epidural anesthesia in the dog, it renamed for Retzgen, Benesch, and Brook to apply the technique of epidural anesthesia in large animal species in the 1960s.

Although paralumber anesthesia was introduced in man by Sellheim in 1909, it was not until the 1940s that Farquharson and Formston applied this technique in cattle.

Despite anesthetic developments in the latter half of the nineteenth century, and perhaps owing to unfavorable results, general anesthesia was not readily adopted by the veterinary profession until well into the twentieth century. A heavy hand, without anesthesia, was the stock in trade of the average veterinarian.

In small domestic animals, Ether and Chloroform were commonly administrated in the early part of the twentieth century.

However, general anesthesia became more widely accepted after discovery of the barbiturates in the late 1920s and, in particular, with the development of Pentobarbital in 1930.

Barbiturate anesthesia received an additional boost with introduction of Thiobarbiturate and particularly with Thiopental in 1934. Because of rough, prolonged recovery, the acceptance of general anesthesia in large animals was delayed until the introduction of preanesthetics such as the Phenothiazine derivatives introduced by Charpentier in France in 1950.

General anesthesia of large farm animals was further advanced by the discovery of Fluorinated hydrocarbons by Raventos and others.
and the development of large animal anesthetic equipment for safe administration.

**Summary on the History of anesthesia**

Modern anesthesia – the ability to produce a **controlled, reversible state** of unconsciousness, amnesia, and muscle relaxation – began in the mid – 19th century. **Nitrous oxide** was first used as an anesthetic in 1844 by the American dentist Horace Wells. In 1846 American dentist William Morton used **Ether** to produce general anesthesia for surgery. Crawford Long, an American surgeon, has been using **Ether** since 1842, but he did not publish his results until 1849. British physician Sir James Simpson first discovered the anesthetic properties of **Chloroform** in 1847. **Chloroform** anesthesia became more popular after another British physician, John Snow, administered it to Queen Victoria of England for childbirth in 1853.

Anesthesiology became an established branch of medicine in the United States during the early 20th century. The American Society of Anesthesiologists, which sets standards of safety and ethics for anesthesiologists, was founded in 1905. The Board of Anesthesiology, which maintains educational standards, was established in 1938. Anesthetic drugs were also improved throughout the 20th century. The first intravenous anesthetic **Sodium pentothal**, was introduced in 1932 by American physician John Lundy. The muscle relaxant **Curare**, originally used in hunting by Native American tribes in South America, was first used in surgery in 1942. Better inhalation anesthetics were also developed to replace **Ether**, which is flammable, and chloroform, which is toxic.
Definitions

Anesthesia: - (from Greek an- "without"; and, aisthēsis, "sensation"), Meaning insensibility or not feeling produced by agents which depress the activity of nervous tissues either locally or centrally.

OR:
Anesthesia is defined as total loss of sensation in a body part or the whole body, induced by a drug or drug combination that depresses activity of nervous tissue peripherally (local and regional anesthesia) or centrally (general anesthesia).

OR:
Anesthesia is a state of unconsciousness produced by a process of controlled, reversible drug – induced intoxication of the CNS in which the patient neither perceives nor recalls noxious stimuli.

A number of terms are used in describing depression of nervous tissues:
1. Analgesia: - The word analgesic derives from Greek αν- ("without") and ἄλγος ("pain"). loss of sensibility to pain (relief pain). Or it refers to freedom from or absence of pain. Or deadening or absence of the sense of pain without loss of consciousness.

2. Narcosis: - state of sleep accompanied by analgesia.

3. Hypnosis: - artificially-induced sleep like state from which the patient can be aroused by stimuli.
   Hypnosis is synonymous with anesthesia as it implies drug – induced sleep.
   While hypnotic is defined as a depressant of the central nervous system which enables the animal to go to sleep more easily, or a drug used to intensify the depth of sleep. They are rarely used in veterinary medicine because the state of sleep, from which the animal is easily aroused by minor stimulation such as noise, is seldom recognizable.

4. Sedation: - calming due to mild degree of depression of central nervous system most sedative cause drowsiness.
   While sedative is defined as a drug which relieves anxiety and as a result tends to make it easier for the patient to rest or sleep – in fact they are usually associated with drowsiness. Many drugs fall into the sedative and the hypnotic categories, the differentiation usually being related to dose.
They are best considered as one group, exemplified by chloral hydrate or xylazine where low doses cause drowsiness and higher doses cause sleep.

5. **Tranquilization**: - a state of behavioral change in which the patient is relaxed and unconcerned by his surroundings.

While tranquilizer (or ataractic) is defined as a drug with a predominant action in relieving anxiety without producing undue sedation.

6. **Local analgesia (anesthesia)**: - It is a loss of sensation in a defined area of the body.

7. **Regional analgesia**: - loss of sensation in a larger but limited body area.

8. **Balanced anesthesia**: - general anesthesia produced by a combination of two or more anesthetic drugs or techniques to achieve optimum hypnosis, analgesia and muscular relaxation.

9. **General anesthesia**: - It is complete unconsciousness produced by a process of controlled, reversible intoxication of C.N.S. in which there is muscle relaxation and diminished to external stimuli.
**Types of Anesthesia**

Anesthesia is often classified according to type of drug and method or route of drug administration:

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1</td>
<td>Inhalation</td>
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<td>Injectable</td>
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<td>Transcutaneous Electric Nerve Stimulation (TENS, TNS, TES)</td>
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<td>Hypnosis</td>
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<td>8</td>
<td>Acupuncture</td>
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<td>9</td>
<td>Hypothermia</td>
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</table>

Or:

√ **Subdivisions of the subject of anesthesia are**:

1. **Local analgesia**
   - (a) By surface application
   - (b) By intra – and subdermal infiltration.
   - (c) Field analgesia: the blocking of an area by linear infiltration of its margins.

2. **Regional analgesia**:
   - (a) By perineural injection
   - (b) Spinal block:
     - (i) By epidural injection
     - (ii) By intrathecal injection

3. **Sedation**
   - (a) In combination with local analgesia
   - (b) As an adjunct to general anesthesia

4. **General anesthesia**
   - (a) By inhalation
   - (b) By intravenous administration of non – gaseous anesthetics (some may be given by intraperitoneal, intramuscular or other routes).
   - (c) By a combination of the above two with or without premedication.

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Indication for anesthesia:
1. Cast application.
2. To capture wild and vicious animals.
3. For diagnosis procedures.
4. To control convulsion (Epilepsy – tetanus).
5. For application of surgical and obstetrical procedures.

Factors affecting general anesthesia:
1. Age: - very young and old animals are more sensitive to anesthesia in comparison to an adult animal.
2. Size and body weight: - The small size animals with higher metabolic rate need large doses of anesthesia per kg body weight.
3. Sex: - Males need more anesthesia than females. However pregnant females are more susceptible due to high metabolic rate.
4. Species of animals: - There are species spesifity and variation.
5. Physical condition of the patient.
6. Pre anesthetic medication and previous drug administration.
7. Type of surgical procedure.

TYPES OF ANAESTHESIA (mentioned previously)

1-Local analgesia
   a- By surface application.
   b- By intra-and sub dermal infiltration.
   c- By field analgesia: the blocking of an area by linear infiltration of its margins.

2-Regional analgesia
   a- By pre neural injection.
   b- Spinal block.
      i- By epidural injection.
      ii- By intrathecal injection.

3-Premedication (Sedation).
   a- In combination with local anesthesia.
   b- As an adjunct to general anesthesia.

4- General Anesthesia.
   a- By inhalation.
   b- By injection of non volatile or nongaseous anesthetics.
      i- Intravenous (most common).
      ii- Sometimes may be given by intra peritoneal, intramuscular or other routes.
   c- By combination of ingestible and inhalation with or without pre-anesthetic.
### Summary of Anesthetics (with some drug's examples)
(for reading only)

<table>
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<th>Adjuncts to Anesthetics</th>
<th>General Anesthetics</th>
<th>Local Anesthetics</th>
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<td>Pre-anesthetic</td>
<td>Muscle Relaxants</td>
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<td>medication</td>
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<tr>
<td>Anticholinergics</td>
<td>Atracurium</td>
<td>Enflurane</td>
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<td>Antiemetics</td>
<td>Succinylcholine</td>
<td>Halothane</td>
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<td>Antihistamines</td>
<td>Vecuronium</td>
<td>Isoflurane</td>
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<td>Barbiturates</td>
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<td>Methoxyfurane</td>
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<td>Benzodiazepines</td>
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<td>Nitrous oxide</td>
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<td>Opioids</td>
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<td>Sevoflurane</td>
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<tr>
<td>Or</td>
<td>Anticholinergics</td>
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<td>Tranquilizers drugs</td>
<td>Tranquilizers drugs</td>
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<td>Narcotics drugs</td>
<td>Sedative drugs and</td>
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<td>adrenergic agonist.</td>
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<td>Neuroleptanalgesics</td>
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<td>Anticholinergics</td>
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<td>Tranquilizers</td>
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<td>Opioids</td>
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<td>Agonists</td>
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<td>Alpha₂-Adrenergic</td>
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<td>Antagonists</td>
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<td>Tranquilizer-Opioid</td>
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<td>combinations</td>
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</table>
LOCAL ANAESTHESIA

Mean temporary loss of sensation in a defined body area without loss of consciousness.

Advantages of local anesthesia:
1- In large animals necessity of casting is avoided.
2- It is easy to perform.
3- Toxicity less than general anesthesia.
4- Useful in patient condition not allowed performing general anesthesia.
5- Post anesthesia risk is reduced.

Contraindications:
1- When there is hypersensitivity to local anesthesia drugs.
2- There is a danger of necrosis in site due to effect of local anesthesia drug on the blood circulation.

Qualities of idea local anesthetic drug:
1- It should be water soluble, stable in solution and easily sterilized.
2- It should have lower systemic toxicity.
3- It should have good penetrating power.
4- It should have rapid onset and long duration of action.
5- It should be not irritant, not painful, and not cause tissue damage.
6- It should have high potency in low concentration.
7- It should be compatible with adrenaline.

Note:
- Local anesthetic agents are divided into two classes:
  (1) Esters (e.g. Procaine) Metabolized by pseudocholinesterases
  (2) Amides (e.g. Lidocaine, Bupivacaine) Metabolized by liver enzymes
- Agents are bases and are charged in acidic media (inflamed tissue).

Toxicity: -
Local anesthetic can produce toxicity two types of symptom, of toxicity:
Local symptoms: - include ischemia and necrosis at site of injection.
Systemic symptoms: - observed when local anesthetic drug reaches the toxic level in circulation which leads to:
1- Decreased cardiac output.
2- Excitement.
3- Nausea and vomiting.
4- Convulsion.
5- Salivation.
6- Coma and death.
Precautionary measures against toxicity:

1- Decrease necessary dose should be used.
2- Decrease concentration of drugs but should be effective.
3- Aspiration prior to any injection to avoid injection directly to mean blood vessel.
4- Addition of adrenaline to slowing the absorption.
5- Use of premedication prior to the use of local anesthetic drug.

Substances commonly used:

1- Cocaine.

   It is no longer in common use as of synthetic compound have replaced it.

   Moreover, it is a strong protoplasmic possession and produces toxicity on absorption. It is being mentioned here as a historical fact.

2- Procaine hydrochloride.

   Is white transparent crystalline powder which is freely soluble in water and easily sterilized. It is less toxic than cocaine .Procaine hydrolyzed by liver and blood stream. It is used for infiltration and spinal analgesia. It is used in 1% with or without adrenaline. Its effect begins within 3-5 minutes after injection and persists for one hour.

3- Lidocaine hydrochloride (xylocaine)

   Commonly used, it is a white powder is readily soluble in water. It is more effective local anesthetic particularly for per neural and spinal injection. It is 3 times more potent than procaine. The addition of adrenaline increases the duration of anesthesia. It is tends to diffuse more widely and easily in tissues. It is used in 1-2% and in 4% for surface anesthesia. The onsets of action begin 1-2 minutes after injection and persist for 1-2 hours.

4- Tutoxaine.

   It is readily soluble in water and stable. It is more potent infiltration anesthetic than procaine. It is used in 2-4 % and the onset of action within 3-5 minutes after injection and persist for 2 hours.

5- Bupivacine.

   It is four times as potent as lignocaine with longer duration of action for that it is indicate where prolonged analgesia is required.
<table>
<thead>
<tr>
<th>Drug</th>
<th>Onset</th>
<th>Duration(hr)</th>
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<tbody>
<tr>
<td>Lidocaine</td>
<td>Fast</td>
<td>2 – 4</td>
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<tr>
<td>Mepivcaine</td>
<td>Fast</td>
<td>1 – 3</td>
</tr>
<tr>
<td>Bupivacaine</td>
<td>Medium</td>
<td>4 - 10</td>
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### Local Anesthetics in clinical use

<table>
<thead>
<tr>
<th>Esters</th>
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<tbody>
<tr>
<td>- Benzocaine</td>
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<tr>
<td>- Chloroprocaine</td>
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<tr>
<td><strong>Cocaine</strong></td>
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<tr>
<td>- Cyclomethycaine</td>
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<tr>
<td>- Dimethocaine/Larocaine</td>
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<tr>
<td>- Pimpleroca</td>
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<tr>
<td>- Propoxycaine</td>
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<tr>
<td><strong>Procaine/Novocaine</strong></td>
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<tr>
<td>- Proparacaine</td>
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<tr>
<td>- Tetracaine/Amethocaine</td>
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<table>
<thead>
<tr>
<th>Amides</th>
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<tr>
<td>- Articaine</td>
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<tr>
<td>- <strong>Bupivacaine</strong></td>
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<tr>
<td>- Cinchocaine/Dibucaine</td>
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<tr>
<td>- Etidocaine</td>
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<tr>
<td>- Levobupivacaine</td>
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<tr>
<td>- <strong>Lidocaine/Lignocaine</strong></td>
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<tr>
<td>- <strong>Mepivacaine</strong></td>
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<tr>
<td>- Prilocaine</td>
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<tr>
<td>- Ropivacaine</td>
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<td>- Trimecaine</td>
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<table>
<thead>
<tr>
<th>Combinations</th>
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<tr>
<td>* Local anesthetics mixed with other local anesthetics include</td>
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</tr>
<tr>
<td>- Lidocaine/prilocaine (EMLA)</td>
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<tr>
<td>- Lidocaine/tetracaine (Rapydan)</td>
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</table>

* Local anesthetics and vasoconstrictors

**Examples include:**
- Prilocaine hydrochloride and epinephrine (trade name Citanest Forte)
- Lidocaine, bupivacaine, and epinephrine (recommended final concentrations of 0.5%, 0.25% and 1:200, respectively)

<table>
<thead>
<tr>
<th>Naturally derived local anesthetics</th>
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<tbody>
<tr>
<td>- Saxitoxin</td>
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<td>- Neosaxitoxin</td>
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<tr>
<td>- Tetrodotoxin</td>
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<tr>
<td>- Menthol</td>
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<tr>
<td>- <strong>Eugenol</strong></td>
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</table>

### Notes:-

1- Clinically useful local analgesic drugs are:
   1- Cocaine
   2- Procaine (trade name Novocain)
   3- Amethocaine (1% instillation into the eye; 2% used for the pharynx and nasal m.m)
   4- Cinchocaine (Nupercaine)
   5- Lignocaine
   6- Prilocaine
   7- Bupivacaine

2- Factors which influence the systemic absorption and potential toxicity of local analgesics (local anesthetics) are:-

   1- The site of injection
   2- The dosage.
   3- The addition of vasoconstrictor agents
   4- The pharmacological profile of the agent itself.
### Properties of Selected Local Anesthetic Agents Used in Veterinary Medicine

<table>
<thead>
<tr>
<th>Agent (Trade Name)</th>
<th>Class</th>
<th>Potency*</th>
<th>Lipid Solubility</th>
<th>pKa</th>
<th>Protein Binding</th>
<th>Onset of Effect</th>
<th>Duration (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procaine (Novocaine)</td>
<td>Ester</td>
<td>—</td>
<td>1</td>
<td>8.9</td>
<td>6%</td>
<td>Slow</td>
<td>60–90</td>
</tr>
<tr>
<td>Chloroprocaine (Nesacaine)</td>
<td>Ester</td>
<td>1</td>
<td>1</td>
<td>9.1</td>
<td>7%</td>
<td>Fast</td>
<td>30–60</td>
</tr>
<tr>
<td>Lidocaine (Xylocaine)</td>
<td>Amide</td>
<td>2</td>
<td>3.6</td>
<td>7.7</td>
<td>65%</td>
<td>Fast</td>
<td>90–200</td>
</tr>
<tr>
<td>Mepivacaine (Carbocaine)</td>
<td>Amide</td>
<td>2</td>
<td>2</td>
<td>7.6</td>
<td>75%</td>
<td>Fast</td>
<td>120–240</td>
</tr>
<tr>
<td>Bupivacaine (Marcaine)</td>
<td>Amide</td>
<td>8</td>
<td>80</td>
<td>8.1</td>
<td>95%</td>
<td>Intermediate</td>
<td>180–600</td>
</tr>
<tr>
<td>Tetracaine (Pontocaine)</td>
<td>Ester</td>
<td>8</td>
<td>80</td>
<td>8.6</td>
<td>80%</td>
<td>Slow</td>
<td>180–600</td>
</tr>
</tbody>
</table>

*Potency is relative to procaine (1).

### Summary on some local anesthetics used in veterinary clinic

| Drug                           | class                                           | MOA                                               | DOA                         | Effect                                                                 | Adverse                                                                 | Approved |
|                                |                                                 |                                                   |                             |                                                                        |                                                                        |         |
| Bupivacaine (Marcaine**) 0.5% | Local anesthetic agent (amide)                   | Blocks nerve transmission by blocking Na channel and preventing excitation-conduction process | 4–6 hr; (epidural, local infiltration) | Reversible prevention of nerve transmission; thus motor, sensory, and autonomic function is temporarily inhibited | CNS excitation, seizures, respiratory paralysis, hypotension, hypothermia, ventricular arrhythmias | Non     |
| Lidocaine (Xylocaine**) 2.0%  | Local anesthetic agent (amide)                   | Blocks sodium influx and thus prevents nerve depolarization and conduction | 90–200 min; (epidural, local infiltration) | Blocks pain, motor, and sympathetic fibers; also used IV to treat ventricular arrhythmias | Hypotension due to vasodilation; respiratory arrest is possible when given epidurally; seizures at high doses | None    |
| Mepivacaine (Carbocaine-V) 1–2% | Local anesthetic agent (amide)                   | Blocks sodium influx and thus prevents nerve depolarization and conduction | 120–240 min; (epidural, local infiltration) | Blocks pain, motor and sympathetic fibers | Hypotension due to vasodilation and respiratory arrest are possible when given epidurally; seizures and cardio toxicity with overdose | None    |
| Procaine (Novocaine)          | Local anesthetic (ester linked)                  | Blocks sodium influx and thus prevents nerve depolarization and conduction | 60–90 min; (local infiltration) | Blocks pain, motor, and sympathetic fibers | May cause allergic reaction | None    |

MOA: is mechanism of action; DOA: is duration of action, these numbers are only guidelines as DOA is influenced significantly by concurrently administered drugs and individual patient status. Route of administration for every agent is listed in parentheses after DOA and includes intravenous (IV), intramuscular (IM), subcutaneous (SC), and per os (PO). In general, the onset of effect occurs within 5 minutes for drugs administered intravenously. When drugs are administered intramuscularly, onset of effect is in 15 minutes; subcutaneous administration requires a slightly longer time to take effect (20–30 minutes). Common trade names (USA; UK* or USA and UK**) for some of the agents have been listed in parentheses after the chemical name.
Local Anesthetics
- Drugs which block impulse conduction in nerves.
  → Act to block voltage-sensitive sodium (Na⁺) channels in nerve membranes
  → Disrupt the action potential
  → Most effective on small unmyelinated fibers applied topically or injected around nerves.

**Mechanism of action:**

At rest high concentration of sodium ions occur outside the cell and reverse for potassium ions

**How do local anesthetic drugs work by block cell permeability**

**Mechanism of action:**

Depolarization occurs when sodium channels open and flow inward

**How do local anesthetic drugs work by block cell permeability**

**Mechanism of action:**

Local anesthetics block the sodium channel to open by prevention the binding between calcium and the phospholipids in the cell membrane
and the following Figure showed the flow of sodium (Na\(^+\)) and potassium (K\(^+\)) triggered by an adequate stimulus.

Methods of local anesthetic application

I- Surface Anesthesia
A. Sprayed or brushed on mucous membranes (mouth, nose, larynx).
B. Dropped into eye.
C. Infused into urethra.
D. Injected subsynovially (synovial membrane)
E. Injected Intrapleurally.

II- Infiltration Anesthesia
A. Diffuse infiltration of operative area
   1. Sensitive tissues: skin, nerve trunks, blood vessels, periosteum, synovial membranes, mucous membranes near orifices (mouth, nose, rectum, anus)
   2. Insensitive tissues: subcuits, fat, muscles, tendons, fascia, bone, cartilage, visceral peritoneum.
B. Infiltration Techniques
   1. Bleb (very localized deposition of a small quantity)
   2. Tissue layer by tissue layer.
C. Uses
   1. Minimize or prevent pain.
   2. Facilitate surgery
      a. Skin incision
      b. Surgical removal of superficial tumors.
      c. Wound repair.

III- Regional (perineural) anesthesia
A. Linear block
B. Field block
C. Peripheral nerve block.
D. Paravertebral block
E. Nerve block: injection in neuroplexus, ganglia, nerve trunks
F. Epidural block
G. Spinal anesthesia: injection in subarachnoid space

IV- Intraarticular anesthesia
V- Subsynovial anesthesia
VI- Intravenous regional anesthesia
VII- Refrigeration or hypothermic anesthesia
Premedications or Preanaesthetic

Pre anesthetic agents are the drugs, which are usually given to prepare the patient for administration of anesthetic agent.

Advantages of use:
1- Reduce the dose of general anesthetic drugs and increase margin of safety.
2- Calm the animal which helps the administration of general anesthetic drug.
3- Induction and recovery are smooth without struggling.
4- Reduce salivary, mucus and bronchial secretions thus keep free airway.
5- Reduce gastric and intestinal motility and prevent vomiting.
6- Block vagovagl reflex thus prevent cardiac slowing or arrest.
7- Some pre anesthetic drugs have analgesic, sedation and muscle relaxation effects.

Groups of pre anesthetic drugs
1- Anti-cholinergic drugs.
2- Tranquilizers drugs.
3- Narcotics drugs.
4- Sedative drugs and adrenergic agonist.
5- Neuroleptanalgesics

Note (for reading only):
Vagovagl reflex a stimulation of the vagus nerve by reflex in which irritation of the larynx or the trachea results in slowing of the pulse rate.
OR: A reflex in which the afferent and efferent impulses travel via the vagus nerve. The afferent impulses travel centrally via the sensory nucleus of the vagus. The efferent impulses travel via the motor fibers of the vagus nerve.
Figure showed the Actions of preanesthetic agents. Adverse effects of stormy induction and/or irritation of responsive cells can be blocked by proper use of preanesthetic agents. Conversely, preanesthetic agents can produce excessive CNS depression, which combined with anesthetic depression, may prove fatal. (Reference: Lumb and Jones' Veterinary Anesthesia; 3rd edition, 1996). (For reading only)
### Premedications or Preanaesthetics

<table>
<thead>
<tr>
<th>Anticholinergics</th>
<th>Alpha₂-Adrenergic Agonists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine Sulfate</td>
<td>Xylazine Hcl (Anased, Rumpun)</td>
</tr>
<tr>
<td>Glycopyrrolate (Robinul – V)</td>
<td>Detomidine (Dormosedan)</td>
</tr>
<tr>
<td>Tranquilizers</td>
<td></td>
</tr>
<tr>
<td>Acepromazine Maleate</td>
<td></td>
</tr>
<tr>
<td>Droperidol</td>
<td></td>
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<tr>
<td>Diazepam (Valium)</td>
<td></td>
</tr>
<tr>
<td>Midazolam (Versed)</td>
<td></td>
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<tr>
<td>Flumazenil (Romazicon)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Alpha₂-Adrenergic Antagonists</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dronedarone</td>
<td></td>
</tr>
<tr>
<td>Tolazoline (Priscoline)</td>
<td></td>
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<tr>
<td>Atepmizole (Antisedan)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Tranquilizer-Opioid combinations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Opioids</td>
<td></td>
</tr>
<tr>
<td>Morphine Sulfate</td>
<td>Etorphine – Acepromazine (Immobilon LA) and</td>
</tr>
<tr>
<td>Meperidine Hcl (Demerol, Pethidine)</td>
<td>Etorphine – Methotrimeperazine (Immobilon SA)</td>
</tr>
<tr>
<td>Methadone Hcl (Methadone, Dolophone)</td>
<td></td>
</tr>
<tr>
<td>Oxymorphone Hcl (Numorphphan)</td>
<td></td>
</tr>
<tr>
<td>Fentanyl Citrate (Sublimaze)</td>
<td></td>
</tr>
<tr>
<td>Carfentanyl Citrate (Wildnil)</td>
<td></td>
</tr>
<tr>
<td>Sufentanil and Alfentanil (Sufenta and Alfenta)</td>
<td></td>
</tr>
<tr>
<td>Etorphine Hcl (M – 99)</td>
<td></td>
</tr>
<tr>
<td>Agonist – Antagonist Opioids</td>
<td></td>
</tr>
<tr>
<td>Butorphanol Tartrate (Torbutrol, Torbugesic)</td>
<td></td>
</tr>
<tr>
<td>Buprenorphine (Buprenex, Temgesic)</td>
<td></td>
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<tr>
<td>Pentazocinc Lactate (Talwin)</td>
<td></td>
</tr>
</tbody>
</table>

#### A- Anticholinergic drugs

1. **Atropine sulfate**: Atropine block acetylcholine at the postganglionic terminations of autonomic nerve. System and act as general parasympathetic.

**Use as pre-anesthetic due to:**

1. Reduce the secretion of bronchi-salivary and mucous gland.
2. It dilates the bronchi and prevents laryngeal spasm.
3. Reduce secretion and motility of G.I.T.
4. Block vagal reflex for that it stabilize the heart and prevent bradicardya and prevent cardiac arrest.
5. It dilates the pupil due to relaxation of sphincter muscles of the iris.

**Contraindications**

1. Tachycardia patients
2. Possibly with geriatrics or with other conditions such as congestive heart failure that could not handle a potential tachycardia
3. Conditions such as constipation and ileus, which would further reduce peristaltic action of the intestine (i.e. endoscope procedures).

**Small animal Dosage**

- Dogs and Cats: 0.02 – 0.04 mg/kg IV, IM, or SQ

**Large animal Dosage**

- Mature cattle: 0.04- 0.06mg/kg
- Sheep and Goats: 0.7 mg/kg
2- **Glycopyrrolate (Robinul-V):**
- Is a synthetic quaternary ammonium anticholinergic.
- Glycopyrrolate inhibits the action of acetylcholine on structures innervated by postganglionic cholinergic nerves and on smooth muscles that respond to acetylcholine and lack cholinergic.
- Glycopyrrolate and atropine produce basically the same effect.
- Glycopyrrolate has a slower onset of action and generally has less potential for producing a tachycardia or cardiac arrhythmia.
- Atropine is more potent and faster acting.
- Glycopyrrolate is used to decrease salivary, tachobronchial, and pharyngeal secretions and the volume and acidity of gastric secretions. **Because** of the increased pH of gastric secretions and decreased intestinal motility, the likelihood of regurgitation is decreased.
- Salivation is more effectively suppressed with glycopyrrolate

### Small animal Dosage

**Dogs and Cats:** 0.005 – 0.01 mg/kg IV, IM, or SQ

### Large animal Dosage

**Cattle and horses:** use during anesthesia: 0.005 – 0.01 mg/kg IM or SQ or 0.0025 – 0.005 mg/kg IV

### Other anticholinergic drugs.

1. **Scopolamine hydrochloride (Hyosine)**
2. **Aminopentamidine**

### Summary of Anticholinergic drugs

<table>
<thead>
<tr>
<th>Dosage forms</th>
<th>Main usage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>- Atropine</strong></td>
<td>- as a preanesthetic to dry secretions</td>
</tr>
<tr>
<td></td>
<td>- and to prevent bradycardia</td>
</tr>
<tr>
<td></td>
<td>- as antidote to Organophosphate poisoning</td>
</tr>
<tr>
<td></td>
<td>- to dilate the pupils for ophthalmic examination</td>
</tr>
<tr>
<td></td>
<td>- To control ciliary spasms of the eye.</td>
</tr>
<tr>
<td></td>
<td>- to treat sinus bradycardia</td>
</tr>
<tr>
<td></td>
<td>- To slow a hyper motile gut.</td>
</tr>
<tr>
<td><strong>- Scopolamine (hyoscine) (levo-duboisine)</strong></td>
<td>- it is used in antidiarrheal medications</td>
</tr>
<tr>
<td><strong>- Methscopolamine</strong></td>
<td>- It is used to control diarrhea.</td>
</tr>
<tr>
<td><strong>- Glycopyrrolate (Robinul – V)</strong></td>
<td>- It is provide longer action than atropine.</td>
</tr>
<tr>
<td></td>
<td>- It is used primarily as a preanesthetic.</td>
</tr>
<tr>
<td><strong>- Aminopentamidine (Centrine)</strong></td>
<td>- it is used to control vomiting and diarrhea in dogs and cats</td>
</tr>
<tr>
<td><strong>- Propantheline (Pro-Banthine)</strong></td>
<td>- it is used to treat diarrhea</td>
</tr>
<tr>
<td></td>
<td>- it is used to treat urinary incontinence</td>
</tr>
<tr>
<td></td>
<td>- It is used to treat bradycardia.</td>
</tr>
<tr>
<td></td>
<td>- It is used to reduce colonic peristalsis in horses to allow rectal examination.</td>
</tr>
<tr>
<td><strong>- Pralidoxime (Protopam, 2-PAM)</strong></td>
<td>- It is used to treat Organophosphate intoxication.</td>
</tr>
</tbody>
</table>

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B- Tranquilizers
   1- Phenothiazine Derivatives
   Are drugs which calm the animal without causing drowsiness, Indications
   Good sedation for healthy animals undergoing elective procedures
   Anti-emetic
   **Use as pre anesthetic due to:**
   1. Produce calmness and permit easy control of animal.
   2. Reduce the dose of general anesthetic drugs due to reduce the
      metabolic rate.
   3. Anesthetic effect.
   4. Spasmolytic effect.

Tranquilizer drugs (phenothazine derivative)
   1- Chlorpromazine HCl. (largactile)
   2- Acepromazine maleate (calmivet)
   3- Propionyl promazine (combelen)

Chlorpromazine:
   1- It is a potent tranquilizer, antiemetic, antiadreline and
      vagolytic action.
   2- It has a potent hypotension effect and depressant action on
      myocardium.
   3- Mild respiratory depression.
   4- It has hypothermic, antispasmodic and anticonvulsant
      properties.

Acepromazine Maleate
   - It is a potent neuroleptic agent with relatively low toxicity.
   - This drug is particularly valuable in dogs, horses, and cats, and
     has been given to a wide variety of wild animals.

Small animal Dosage
   Dogs: 1 – 3 mg/kg orally
   0.03 – 0.1 mg/kg IV, IM, or SQ (not to exceed the total dose of 3 mg/kg).
   Cats: 0.03 – 0.1 mg/kg

Large animal Dosage
   Horses: 0.02 – 0.05 mg/kg
Tranquilizers

**-Phenothiazine Derivatives**
* Acepromazine maleat (Acepromazine, Promace)
* Chlorpromazine HCl (Thorazine)
* Promazine HCl
* Prochlorperazine /isopropamide (Darbazine, Compazine)

**Mechanism of action**: on CNS is not well understood. It has been proposed that they are Dopamine blockers.
- They approved for use in wide variety of animals, and for administration by almost any rout.
- They are relatively safe drugs to use when administered appropriately.
- They should be given with care when used with other CNS depressants because of the additive effect.
- Most phenothiazine derivatives are metabolized by the liver and excreted by the kidneys.
- They can cause hypotension and hypothermia because of their vasodilator effect (alpha blockade).
- They also can induce seizures (by lowering the seizure threshold) in epileptic animals.
- **They should not be used within 1 month of worming with organophosphate anthelmintic**.
- The tranquilizing effect may be reduced in an excited animal.

**-Benzodiazepine derivatives**
* Diazepam (Valium, Vazepam)
* Midazolam

*Mode of action*: (a) Exert many of their pharmacologic effects by enhancing the activity of CNS inhibitory neurotransmitters and opening chloride channel, thereby hyperpolarizing membranes; also produce their effects by combining with CNS benzodiazepines receptors (BZ1, BZ2). Effects can be **antagonized by** the benzodiazepines antagonist Flumazenil.
(b) Depress the limbic system, thalamus, and hypothalamus (reducing sympathetic output), thereby inducing a mild calming effect.
(c) Reduce polysynaptic reflex activity, resulting in muscle relaxation.
(d) Cause minimal CNS depression and produce anti-convulsant effects in most animals; may cause disorientation and agitation after rapid IV administration, particularly in cats.
(e) Stimulate appetite and pica.

**Alpha₂-Adrenergic Agonists**
* Xylazine (Rompun)
* Detomidine
* Medetomidine

*Mode of action*: produce CNS depression by stimulating both presynaptic alpha₂-adrenoreceptors in the CNS and peripherally.
- decreasing nor-epinephrine release centrally and peripherally reducing ascending nociceptive transmission.
The net result is a decrease in CNS sympathetic outflow and a decrease in circulating catecholamines and other stress-related substances; the CNS effects of alpha₂-agonists can be antagonized by alpha₂-receptor antagonists.
C-Narcotic analgesic
- Act by reversible combination with one or more specific receptors in the brain and spinal column
- Produces a variety of effects
  - Analgesia
  - Sedation
  - Dysphoria
  - Euphoria
  - excitement
- Act as an agonist or antagonist
- Pure agonists stimulate all receptors – morphine, fentanyl and oxymorphone
- Mixed agonists/antagonists block one type of receptor and stimulate another
- Pure antagonists such as naloxone will reverse the effects of pure and mixed agonists with very little clinical effect on their own
- Also classified according to their analgesic activity and their addiction potential
- Pure agonists are more effective for severe pain in order of decreasing potency they are:
  - **Fentanyl**
  - **Oxymorphone**
  - **Buprenorphine**
  - **Meperidine**
  - **Pentazocine**

Commonly used as an analgesic in premedication, as an induction agent or can be used for balanced anesthesia and post-operative pain control. Provides some sedation and may potentiate the action of the sedative that it is given with has a synergistic effect.

Fentanyl, sufentanil and oxymorphone are often part of a balanced anesthetic regimen.

Fentanyl is available as a transdermal patch in various sizes for long-term analgesia Used as neuroleptanalgesia in combination with tranquilizer. Morphine can be injected epidurally or sub-arachnoidally for regional analgesia.
Morphine and its substitutes:
- It has a potent analgesic and sedative action due to depression of the sensory area of cerebral cortex.
- It has a potent respiratory depression and hypotension action.
- It stimulate vomiting center and gastrointestinal tract for that it is contraindicated in intestinal obstruction.

Contraindications
- Previous history of opioid excitement.
- Morphine has a higher incidence of producing vomiting so should be avoided in cases of GI obstruction and diaphragmatic hernia.
- Morphine has both excitement and depression effect. The final effect depends on three factors
  1. Species of animal.
  2. Dose.
  3. Rate of administration
- Excitement occurs if given rapidly IV.
  - Horse and cat are particularly susceptible to excitatory effects.
  - Dogs generally show sedation although hypnosis can be seen in higher doses in sick animals.
  - Dogs that are not in pain may show excitement
  Excitement symptom: mydriasis, nausea and convulsion.
  Sedation symptom: miosis, respiratory depression, bradycardia, hypothermia.
- Morphine causes excitement in cat and pig and sheep in horse it may cause sedation and sometime excitement.

Other narcotic analgesic:
- Pethidine
- Methadone
- Etorphine
- Fentanyl
**Butrphenol**

Act by reversible combination with one or more specific receptors in the brain and spinal column

Produces a variety of effects:
- Analgesia
- Sedation
- Dysphoria
- Euphoria

Other effects in addition to analgesia
- Respiratory depression is dose dependent
- Gastrointestinal effects depend on the agent
- May initially include diarrhea, vomiting and flatulence
- Constipation may occur as a result of prolonged GI stasis
- Addiction

**Opioids**

Other effects in addition to analgesia
- Body temperature decreases and panting in dogs due to a resetting of the thermoregulatory center in the brain
- Miosis in dogs and pigs and mydriasis the cat and horse.
- Increased responsiveness to noise
- Cough suppression
- Excessive salivation
- Sweating, particularly in the horse excitement.

**Sedative (α₂ adrenergic agonist)**

- α₂-Agonists
  - Are derivatives of thiazine
  - Examples:
    - Xylazine (Rompun, Anased)
    - Romifidine
    - Medetomidine (Domitor)
- Detomidine
  - Agonists
  - Stimulates the α₂-adrenoceptors causing a decrease in nor epinephrine

**Indication**
- Potential side effects limit use to sedation only, not for preanesthetic medication
- Can use to sedate a vicious animal
- α₂-Agonists
  - Have some short-lived (16 to 20 minutes) analgesic effects
  - Will cause vomiting in up to 50% of dogs and 90% of cats
Xylazine and Detomidine are used most frequently in horses

- before euthanasia

- $\alpha_2$-Agonists

**Contraindications**

- Considerable potential for side effects especially if administered IV
- Profound cardiovascular effects include bradycardia, profound hypotension, decreased contractility and stroke volume and second degree heart block
- Contraindicated when concerned about respiratory function, hepatic and renal function and if the animal is prone to gastric dilation
- Associated with temporary behavior and personality changes
- Reduces pancreatic secretions causing transient hyperglycemia (exacerbates dehydration)
- Opioids will exacerbate these side effects

**Xylazine**

1. It is a potent sedative, analgesic and muscle relaxant.
2. It has wide margin of safety and increasing dose not increase the depth of sedation and duration.
3. Its cause mild hypotension and respiratory depression and partial A.V. Block (atrio – ventricular).
4. It is drug of choice for bovine and horse but the dose in horse is tenth time more than in bovine.
5. Sedative effect of xylazine cause lowering of head drooping of eyelid and lower lips.

**Table showed the tranquilizing dose of Xylazine in several spp. (mg/kg).**

<table>
<thead>
<tr>
<th>Species</th>
<th>IV</th>
<th>IM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog</td>
<td>0.025 – 0.5</td>
<td>0.5 – 1.0</td>
</tr>
<tr>
<td>Cat</td>
<td>0.025 – 0.5</td>
<td>0.5 – 1.0</td>
</tr>
<tr>
<td>Horse</td>
<td>0.4 – 1.1</td>
<td>1.0 – 2.0</td>
</tr>
<tr>
<td>Cattle</td>
<td>0.03 – 0.1</td>
<td>0.1 – 0.2</td>
</tr>
<tr>
<td>Sheep</td>
<td>0.025 – 0.1</td>
<td>0.1 – 0.3</td>
</tr>
<tr>
<td>Goat</td>
<td>0.05 – 0.1</td>
<td>0.1 – 0.3</td>
</tr>
</tbody>
</table>

**Other $\alpha_2$ adrenergic agonist:**

Detomidine
Medetomidine
Antidoate yhambine
**Other sedative from benzodiazepine:** (Benzodiazepines)

**Tranquilizers**

**Examples:**

- Diazepam (Valium)
- Midazolam (Versed)
- Lorazepam (Ativan)

**Indications**

- Convulsing/epileptic patients.
- Patients with a history of seizure.
- CSF taps or myelogram procedures.
- Minimal cardiovascular or respiratory depression.
- Useful in geriatric or pediatric animals.
- Ideal for older, depressed or anxious patients.
- Works effectively as an induction agent when used with ketamine.

**Benzodiazepines (Benzodiazepines)**

**Contraindications**

- May cause excitement in some dogs, cats and horses
- Does not sedate animal but has anti-anxiety and calming effects
- May make animal more difficult when inhibitions and anxieties are removed
- Neonatal animals and animals with poor hepatic function

**Diazepam** (Valium) does not sedate animal but has antianxiety and calming effects
- May make animal more difficult when inhibitions and anxieties are removed

**Neonatal animals and animals with poor hepatic function**

**Diazepam (Valium)**

1. It is a potent sedative muscle relaxant and anti convulsion.
2. It potentiates general anesthetic drugs and reduces the dose required.
3. Slight respiratory and cardiovascular depression.

Table showed the tranquilizing dose of diazepam in several spp.

<table>
<thead>
<tr>
<th>Species</th>
<th>Rout</th>
<th>Dose mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog and cat</td>
<td>IV</td>
<td>0.1 - 0.5</td>
</tr>
<tr>
<td></td>
<td>IM</td>
<td>0.3 – 1.0</td>
</tr>
<tr>
<td>Horse</td>
<td>IV</td>
<td>0.05 – 0.2</td>
</tr>
<tr>
<td>Cattle, Sheep</td>
<td>IM</td>
<td>0.5 – 1.0</td>
</tr>
</tbody>
</table>
### Opioids Agonists

<table>
<thead>
<tr>
<th>Naturally occurring Narcotics</th>
<th>Synthetic Narcotics</th>
<th>Moe of action: Act by reversible combination with one or more specific receptors (i.e. μ, κ, δ) in the brain and spinal cord to produce a variety effects including analgesia, euphoria, dysphoria, and excitement.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opium</td>
<td>Meperidine (Demerol)</td>
<td>The opioids are used as preanesthetic or post-anesthetic because of their sedative and analgesic properties.</td>
</tr>
<tr>
<td>Morphine sulphate (Duramorph)</td>
<td>Oxymorphone (Numorphan)</td>
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<tr>
<td></td>
<td>Butorphanol tartrate (Torbutrol, Torbugesic)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fentanyl (Sublimaze)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hydrocodone bitartrate (Hycodan, Tussion)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Etorphine (M-99)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pentazocine (Talwine, Takwin-V)</td>
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<tr>
<td></td>
<td>Diphenoxylate (Lomotil)</td>
<td></td>
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<tr>
<td></td>
<td>Apomorphine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Methadone (Dolophine)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Codeine</td>
<td></td>
</tr>
<tr>
<td>*Carfentanil (Wildnil)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Buprenorhine (Buprenex)</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Opioid Antagonists</th>
<th>Neuroleptanalgesics</th>
<th>They block the effects of Opioids by binding with opiate receptors, displacing narcotic molecules already present, and preventing further narcotic binding at the site.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classified in to:</td>
<td>Fentanyl + Droperidol (Innovar – Vet)</td>
<td>These agents consist of an Opioid and a tranquilizer. these are used for sedation, restraint and to produce anesthesia.</td>
</tr>
<tr>
<td>- Pure antagonists</td>
<td>Acepromazine + Morphine</td>
<td></td>
</tr>
<tr>
<td>- Partial antagonists</td>
<td>Xylazine + Butorphanol</td>
<td></td>
</tr>
<tr>
<td>(may have some agonist</td>
<td></td>
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<td>activity).</td>
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<tr>
<td>* Nalaxone (Nalaxone HCl, Naracan)</td>
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<tr>
<td>* Nalorphine (Nalline)</td>
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Clinical uses: Opioid agonists are used for analgesia, sedation, restraint, anesthetics, treatment of coughing, and treatment of diarrhea.

Adverse side effects: these can include respiratory depression, excitement (cat and horses), nausea, vomiting, diarrhea, defecation, panting, and convulsion. Overdose causes profound respiratory depression.
Neuroleptanalgesia:
Any combination of an analgesic and a tranquilizer (i.e. oxymorphone and acepromazine)( Acepromazine + Fentanyl)
(Droperidol + fentanyl)
Or combination between
Sedative + Narcotic analgesic
Like
(xylaxizine + Morphine)
(xylaxizine + Butorphenol)
Indications
i. Heavier sedation (depending on dose) for short procedures (i.e. wound suturing, porcupine quill removal)
ii. Cardiac or shock cases
Contraindications
iii. Animal may become hyperactive to auditory stimuli
iv. Animal may defecate or vomit
v. May hyperventilate, or pant a lot
vi. May cause bradycardia.
Muscle Relaxant

The drugs which causes relaxation of voluntary muscles by acting on the neuromuscular junction or spinal cord.

**Indication:**
1. To produce good muscle relaxation during surgical operation i.e. orthopedics or deep abdominal surgery.
2. To facilitate endotracheal intubations.
3. To facilitate ventilation in thoracic surgery.
4. To facilitate correction of dislocated joint.
5. To decrease the doses of general anesthesia.

**Contraindication:**
1. In animal with respiratory, liver or kidney diseases.
2. In animals suffering from glaucoma.
3. In animals being recently (30 days) treated with any antibiotics the name which ends in *mycin* or with *organophosphorus* compound because these drugs increase the intensity of paralysis and prolong the recovery period.
4. Muscle relaxant drug should not be used without general anesthesia.

**Mode of action of Muscle contraction**

Motor nerve impulse → Motor nerve ending → Release of acetylcholine → binding of acetylcholine with protein receptor on the end palate of muscle → action potential → muscle contraction

**Mechanisms of skeletal muscle relaxation by interfering with normal neuromuscular function**

**I. At presynaptic site:**
   a. Inhibition of Ach synthesis (blocks choline uptake).
   b. Inhibition of Ach release:
      1. Calcium deficiency, Mg$^{++}$ increase.
      2. Procaine.
      3. Tetracycline and aminoglycoside antibiotic.

**II. At postsynaptic site:**
1. Competitive block of Ach (Non depolarization agent).
2. Depolarization agent. Which case persistent depolarization and have longer duration of actions than Ach.
Specific neuromuscular blocking drugs
(Clinically drugs use as muscle relaxant)
1. Depolarizing drugs act like Ach
   Ex:   A. suxamethonium.
         B. succinylcholine.
   - These drugs are generally free from complication.
   - Large dose may produce hypertension.
   - There is wide species variation horse, pig and cat are relatively resistant, dogs and sheep and cattle good action.
   - It does not cross the placental barrier.
   - The duration of action may prolonged by I.V adminstor.
2. Non depolarizing drugs (competitive blocking drugs)
   Ex:
   1-d- Tubocurarine chloride
   - It cause severe fall in blood pressure.
   - No direct action on liver or kidney.
   - Case release of histamine.
Calamine (flaxedil)
   - Vagolytic action case tachycardia.
   - Cross the placental barrier.
   - No direct action on liver or kidney.
   - Drug of choice in dog.
   - Action of calamine can be reversed by neostigmine.
Sequence of muscle relaxation:
Oculomotor m → Palpebralm → Facials → Tongue and pharynx → Jaw and tail → Limbs. m. → pelvis m. → caudal abdominal m. → cranial abd. m. → Intercostal m. → larynx → diaphragm

  - Recovery is generally in the reverse order of paralysis.