College of Veterinary Medicine
Department of Surgery & Theriogenology

Local and regional anesthesia 2019 1st lecture

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- References

- 1. Thurmon, Tranquilli and Benson Veterinary Anesthesia Williams and Wilkins 1996
- 2. Hall, Clarke, and Trim Veterinary Anesthesia WB Saunders 2000
- 3. Muir, Hubbel and Skarda A handbook of Anesthesia Mosby 1999
- 4. Local & Regional Anesthesia From Internet researches
- 5. hand book of anesthesia

- **Local anesthesia**
- Define as the use of chemical agents on sensory neurons to produce disruption of neuron impulses transmission, leading to a temporary loss of sensation just in a small area of body where a minor procedure is to be done.
- **Regional anesthesia**
- Define as the loss of sensation in a large area. It does not make the patient unconscious. but still in a limited part of body.
- Perineural anesthesia are examples o f regional anesthesia.

Mechanism of action

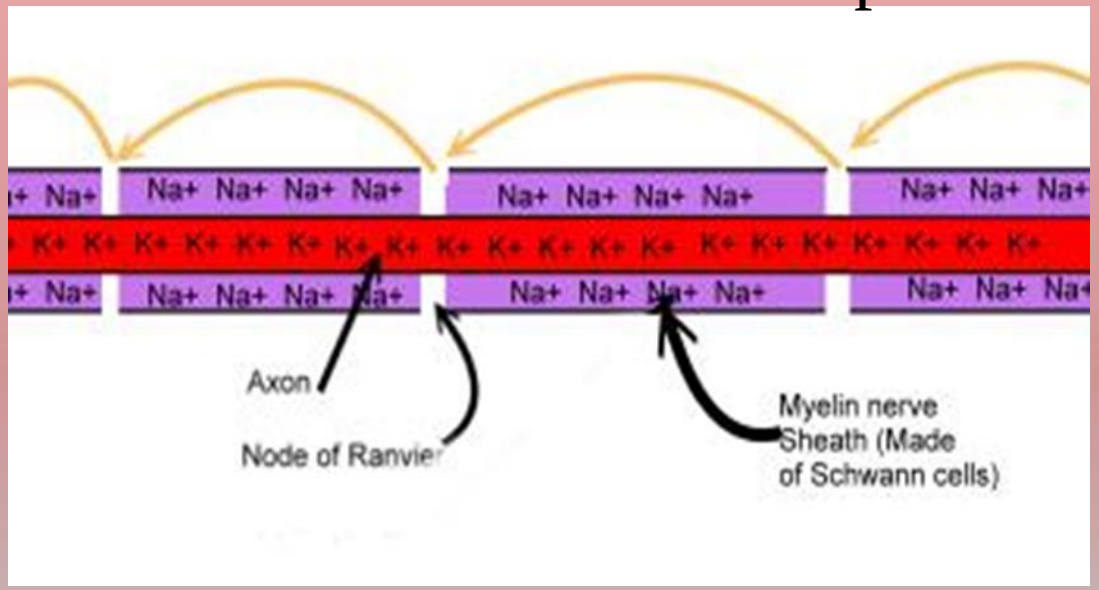
1. Local anesthetics prevent depolarization of nervous tissues by blocking the Na channel in the cell membrane.

2. They prevent activation of peripheral nociceptors and block transmission of impulses along nerve fibers.

3. It appears that the unionized molecule must diffuse into the nerve tissue where it then ionizes and binds to the cytoplasmic side of the Na channel rendering it inactive. In myelinated nerve fibers the drug gains access to the nerve at the node of Ranvier. It has been shown that 3 consecutive nodes are the minimum number needed to be blocked to prevent transmission.

4. There is evidence to suggest that local anesthetics can also exert their activity by blocking calcium channels and inhibiting reuptake of the inhibitory neurotransmitter GABA, thus enhancing its effect.

How a nerve fiber transmits an impulse



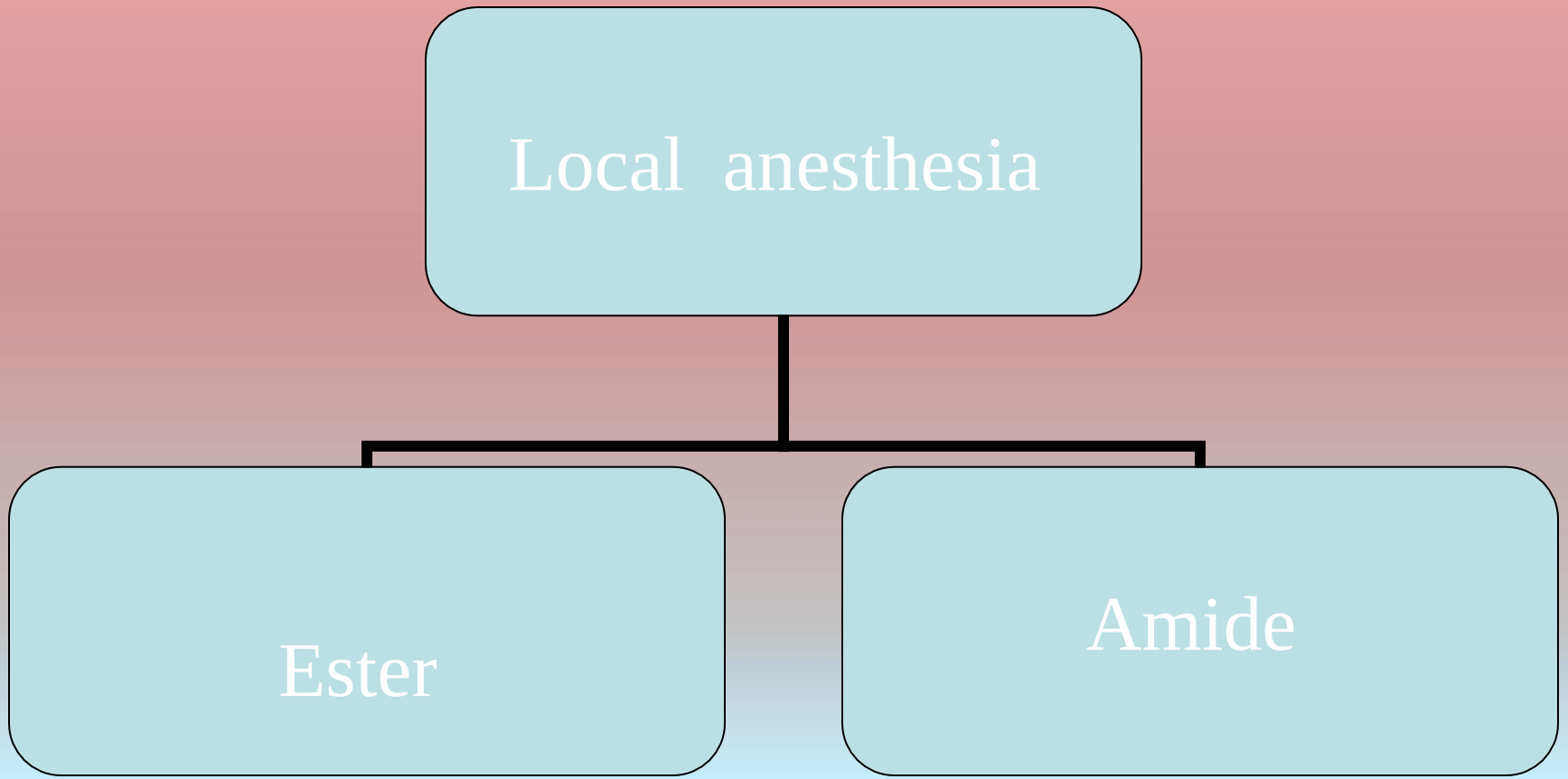
Nerves are NOT like electrical wires with electrons traveling their length to transfer information from one end to the other.

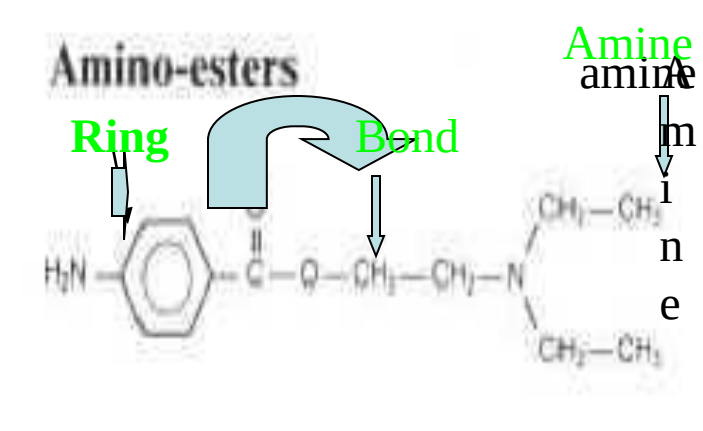
- They are actually complex electro-chemical structures which utilize the electrical potential difference between the fluid inside of the axon, and the fluid that surrounds the axon.
- The fluid inside the axon (called cytoplasm) contains a high concentration of potassium ions, while the fluid outside contains a high concentration of sodium ions.
- Sodium ions want to flow into the nerve cytoplasm, while the potassium ions want to flow out, but both are prevented from doing so by the presence of the nerve cell membrane.

Characters of the local anesthetic agent

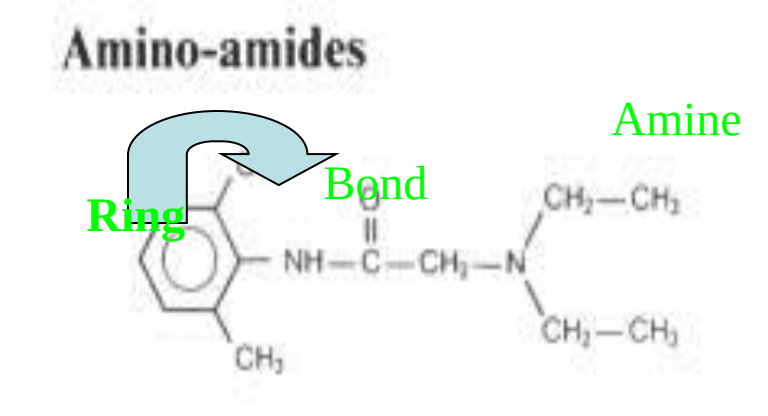
- 1. Good penetrating qualities in the body tissue.
- 2-High potency so low concentration can be used
- 3- Rapid onset of action
- 4-Long duration of action
- 5-low systemic reaction
- 6-Reversible action
- 7-No irritation to nerve
- 8- Ease of sterilization .

Structure of local anesthesia





procaine



lidocaine

- 1. The diagrams show the essential structures of the two major types of local anesthetic agent; the molecule shown in of procaine (Novocain).
- The chain that connects the benzene ring on the left with the amide tail on the right is an "ester linkage".
- 2. The diagram to the right represents lidocaine and its analogs. The connecting chain in this case is called an "amide linkage". The amide linkage contains an extra nitrogen to the left of the C=O (carboxyl) group.

- **Classification of LA:**
- *1.* ***Procaine and chlorprocaine*** are of low potency and have a short duration of action.
- *2.* ***Mepivacaine, prilocaine and lidocaine*** are of intermediate potency and duration.
- *3.* ***Tetracaine, bupivacaine, etidocaine and ropivacaine*** are of high potency and duration.

Toxicity of local anesthesia

- **Toxic reactions** to local anesthetics include local tissue reactions including inflammation and necrosis.
- Systemic reactions are a result of
- A. inadvertent intravascular injection or over dosage and systemic absorption.
- B. Cardiovascular reactions include bradycardia and or conduction disturbances, myocardial depression and peripheral vasodilatation. decreased myocardial contractility, peripheral vasodilatation
- C. CNS toxicity is dose dependent and ranges from depression (excitement, seizures, sedation) progressing to excitation, muscle twitching and convulsions.
- Large doses produce generalized CNS depression. CNS signs of toxicity usually occur before cardiovascular changes occur.
- **Allergic reactions** may also occur and are most commonly associated with the esters.

- **Ester-linked**. Local anesthetics are readily hydrolyzed in the blood by plasma cholinesterase whereas amides undergo hepatic metabolism.
- Lipid solubility of the drug determines the intrinsic local anesthetic potency.
- **Protein binding determines** *the duration of action* and ***pKa determines the rate of onset of action***.
- Greater lipid solubility, a high degree of protein binding and a pKa near physiologic pH will result in rapid onset, long duration and greater potency.
- 1. The ester local anesthetics as ***procaine***, ***chorprocaine*** and *tetracaine*.
- 2 The amides as ***lidocaine***, ***mepivacaine***, *bupivacaine*, ***etidocaine***, ***prilocaine***, and ***ropivacaine***.

History

- 1. Surprisingly, the first local anesthetic was **Cocaine** which was isolated from coca leaves by Albert Niemann in Germany in the 1860s.
- 2. The first clinical use of **Cocaine** was in 1884 by (of all people) Sigmund Freud who used it to wean a patient from morphine addiction.
- 3. Kollar first introduced it to **clinical ophthalmology** as a topical ocular (eye) anesthetic.
- 4. The first synthetic local anesthetic was **procaine**, better remembered today by its trade name, "**Novocain**".
- 5. In 1930 tetracaine was introduced.
- 6. In 1943 an alternative class of anesthetic was discovered when Lofgren developed **lidocaine**

Factors influence the properties of LA

1. 1. Spreading properties. Good Spreading properties mean that specific nerve blocks need less accuracy.
2. 2. Speed onset of action.
3. 3. Duration of action (mechanisms limiting this, which include speed of removal from tissue and metabolism and removal from the body.)
4. 4. Effects on the local blood vessels. Vasodilatation (therefore epinephrine is often added to cause Vasoconstriction, thus delay removal and lengthen action) except cocaine only is Vasoconstriction.
5. 5. Local irritation and swelling (particularly in horses).
6. 6. Toxicity.

Systemic and toxic effects of local anesthetics.

1. Always draw back on syringe to check not in vein before injecting local anesthetics.
2. Accidental intravenous injection of local anesthetics is the most common cause of adverse reaction associated with local anesthetic administration. In severe cases it can cause cardiac arrest. Bupivacaine is more cardiotoxic than Lidocaine.
3. Signs of overdose are initial sedation, followed with increasing dosage by twitching, convulsions, coma and death. Reports implicate prilocaine, benzocaine, lidocaine and procaine as causative agents to produce methemoglobinemia in some animals.its likely with benzocaine or prilocaine but also reported with procaine and lidocaine. Also more likely in cats than dogs . Clinical signs Hypoxia, cyanosis, death, blood that looks brown in color, dyspnea, nausea, tachycardia

Aims for the uses of local anesthesia:

1. Many surgical procedures can be carried out satisfactorily under local anesthesia such as cesarean section, neoplasm, laparotomy and docking in ewe or cows.
2. In some situations with **extremely depressed** animals when they will tolerate, performing a surgical procedure under local anesthesia may be safer as well as more economical.
3. It is effectively used for differential diagnosis of lameness especially in equine.
4. Local anesthesia has useful role in obstetrics maneuvers.
5. The **sedation is often employed** to facilitate cooperation from animals by reducing fear and anxiety. The sedation also reduces the likelihood of sudden movement in animals.