Anesthesiology

Introduction:

anesthesia is regarded one of the miracles of medicine , and is most important in surgery.
Advances in the art and science of anesthesia have allowed tremendous advances in surgery and medicine.
General anesthesia is a state of unconsciousness produced by controlled, reversible
drug-induced intoxication of the central nervous system resulting in absence of pain sensation over the entire body and a greater or lesser degree of muscular relaxation.
Therefore, general anesthesia should ensure immobilization, unconsciousness, and
loss of pain.

History of Veterinary Anesthesia

1540 Paracelsus reported use of ether to anesthetize fowl
1800 - Sir Humphry Davy suggested anesthetic effect of nitrous oxide
1824 Hickman produced analgesia in dogs with mixture of nitrous oxide and carbon dioxide
1842 Ether first used in human anesthesia
1844 Wells used nitrous oxide in his dental patients
1847 Chloroform used in animals and human by Fluorens and Simpson, respectively
1862 Nitrous oxide reintroduced in humans
1875 Chloral hydrate introduced
1878 Cocaine suggested for local anesthesia
1930s Barbiturates introduced
1950 Phenothiazine tranquilizers
1956 Halothane introduced
1971 Xylazine and ketamine introduced
1975 Establishment of the American College of Veterinary Anesthesia
1985 Isoflurane introduced
1989 Propofol introduced
1990s Sevoflurane and desflurane introduced

Aims of Anesthesia

1. Provide relief from pain
2. Provide optimal condition for surgery and other procedures
3. Ensure patient safety and survival

Nomenclature of Anesthesia

Anesthesia - the loss of sensation
Analgesia - freedom from or absence of pain
Local anesthesia/analgesia - loss of sensation in a prescribed body area (usually infers blockade of a specific nerve or infiltration of a small area with local anesthetic, e.g. intercostal nerve block)
Regional anesthesia/analgesia - loss of sensation in a larger, though limited body area
(usually infers blockade of a large nerve or group of nerves with local anesthetic, e.g. epidural anesthesia)
General anesthesia - loss of sensation to the entire body. The state of reversible
unconsciousness, muscle relaxation, and analgesia.
Tranquilization - state of reduced anxiety and relaxation, but still aware of
surroundings
Sedation - state of CNS depression and drowsiness; including reduced awareness of surroundings
Narcosis - drug induced state of deep sleep, from which the patient may or may not be arousable
Surgical Anesthesia - stage/plane of general anesthesia that provides unconsciousness,
muscle relaxation, and analgesia to allow surgery
Balanced Anesthesia - Combining several drugs to induce anesthesia in concentrations that are considerably smaller than those needed if one drug were to be used by itself; which typically involves the co-application of a hypnotic drug, an analgesic drug and a muscle relaxant.
Dissociative Anesthesia - the state of anesthesia produced by drugs (e.g. ketamine) that disassociate the thalamocortic and limbic systems, resulting in a cataleptoid state, characterized with open eyes and hypertonous muscles
Neuroleptanalgesia - combination of a neuroleptic agent (tranquilizer/sedative) and an analgesic agent to produce a state of heavy sedation and analgesia (e.g. -
acepromazine + morphine)

Type of Anesthesia

1- local anesthesia
2- General anesthesia

Local Anesthesia

Local anesthetics are a group of chemically related compounds that reversibly bind sodium channels and block impulse conduction in nerve fibers.1 The interruption of neural transmission in sensory afferent nerves or tracts by a local anesthetic drug after local tissue infiltration, regional nerve blocks, or epidural or intrathecal (subarachnoid) injection uniquely and most effectively prevents or reduces pain or nociceptive input during and after surgery.

- Many surgical procedures can be carried out satisfactorily under local anesthesia (e.g., C-section in cows).
- 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.
- The techniques are not difficult to learn and do not involve the use of expensive or complicated equipment

Mechanism of action of local anesthesia

1- LAs block nerve conduction by inhibiting influx of sodium ions through ion-selective sodium channels in nerve membrane leading to impairment of the generation of action potential.

2- The sodium channel itself is a specific receptor for local anesthetic molecules

Factor Affecting on Local Anesthesia(LA)

1- Acidosis in the environment into which the local anesthetic is injected (as is present in an infected, pus tissue) further increases the ionized fraction of drugs. This is consistent with slower onset and poor quality of local anesthesia when a local anesthetic is injected into an acidic infected area.
2- Local anesthetics with a higher degree of protein binding have a prolonged duration of action. Increased dose increases the duration of the block.
3- Thin nerve fibers are more easily blocked than thick ones. However, myelinated fibers are more readily blocked than unmyelinated ones because of the need to produce blockade only at the node of Ranvier.
4- The lipid solubility and pKa of the local anesthetic are the primary determinants of the degree of differential blockade.

Administration of local anesthesia

1. *Infiltration or infusion*- injection beneath the skin and other tissue layers along the site of an incision before or after a procedure
2. *Field block, ring block*- injection into soft tissues distant from the actual incision in a pattern that intersects the nerve supplying the surgical site
3. *Nerve conduction block*- infusion of a small amount of drug or directly adjacent to the sheath of a nerve supplying the surgical site
4. *Regional or spinal anesthesia*- injection into the vertebral canal, epidurally or into the sub-arachnoid space. To avoid systemic toxicity, care must always be taken not to inject local anesthetics into blood vessels.
5. Topical local anesthetics, such as lidocaine jelly, may be useful for some surgical wounds.
6. Proparacaine and tetracaine may be used as a local anesthetic during retroorbital blood collection from mice. One drop on the eye, wait 10-15 minutes before performing the procedure.

Type of Local Anesthesia (LA)

-Surface (topical) anesthesia

-Intrasynovial anesthesia

- Infiltration anesthesia

- Spinal anesthesia

- Intravenous regional local anesthesia

- Regional anesthesia

1-Surface (topical) anesthesia

This refers to the use of local anesthetics in solution sprays as well as in various creams and ointments, on mucous membranes; drops into the eye; sprays or brush in laryngeal area, infuse into the nostrils, urethra, or rectum.

2- Intrasynovial anesthesia

-In joints, bursa, and tendon sheaths.

-Useful for both diagnosis of lameness, and for general pain relief.

-The local anesthetic chosen must cause minimal irritation, and great care in sterility is necessary as infection in these sites occurs easily.

3- Infiltration anesthesia

- By this method the nerve endings are affected at the actual site of operation.

- Most minor surgery can be done this way, excluding surgery on teats in cattle or small animal digits.

- Problems occur through infection (never inject local analgesic through infected tissues), irritation, distortion of the wound, swelling and some delay in post-operative healing.

4- Spinal anesthesia

- Spinal anesthesia is the injection of local anesthetic around the spinal cord.

- When local anesthetics such as lidocaine or bupivacaine are used, all the segmental nerves (sensory and motor) which pass through the anesthetic are paralyzed, although when opioids are used only sensory block occurs.

- Spinal anesthesia is divided into two types; 'epidural' and 'true spinal'.

a- Epidural (or extradural) anesthesia refers to depositing of local anesthetics into the extradural space. The needle enters the spinal canal, but does not penetrate the meninges. The anesthetic is therefore limited to the canal outside the dura mater.

b-True spinal anesthesia refers to the **subarachnoid** access (usually known as 'spinal' anesthesia) in which the needle penetrates the dura mater, and the analgesic is injected into the cerebrospinal fluid (CSF).

Dangers of spinal and epidural block

1- Infection- Careful sterile precautions (**good clipping and scrubbing**)

2- Irritation causing spinal damage (most likely with subarachnoid).

3- Hind-limb motor paralysis (problem in large animals, acceptable in small).

4-Hypotension - most likely with an anterior block. Where this is being done fluid therapy or inotropes should be available to maintain blood pressure.

5-Respiratory paralysis (only if massive overdose of local analgesic used).

5-Intravenous regional local anesthesia (Bier's block)

-In this technique, a limb vein is catheterized.

- The limb is a tourniquet placed around the limb, at a pressure adequate to prevent arterial circulation (> 150 mmHg).

- Local anesthetic (preferably without epinephrine) is then injected into the vein.

- After a period of 15 minutes the area distal to the tourniquet is anesthetized until the tourniquet is removed.

6-Regional anesthesia

-This term is used where specific nerves to the area concerned are blocked.

- Examples include specific nerve blocks

a- Paravertebral anesthesia : refers to the peri-neural injection of local anesthesia about the spinal nerves as they emerge from the vertebral canal through the intervertebral foraminae. • The technique may theoretically be carried out in any species, and at any level of the spinal cord but in practice, its main use is to provide anesthesia of the lumbar region in ruminants.

b- Proximal paravertebral block (Cambridge Technique) : Indicated for standing laparotomy surgery such as C-section, rumenotomy, cecotomy, correction of gastrointestinal displacement, intestinal obstruction and volvulus. The dorsal aspect of the transverse processes of the last thoracic (T-13) and first and second lumbar (L-1 and L-2) vertebrae is the site for needle placement.

c-Distal paravertebral block (Cornell technique) : Indicated for same as proximal paravertebral block above. The dorsal and ventral rami of the spinal nerves T13, L1 and L2 are desensitized at the distal ends of L-1, L-2 and L-4.

d- Local nerve blocks of the head: (Cornual nerve block. Cattle) Indicated for dehorning and treating horn injury. Ophthalmic division of the fifth cranial nerve, Injected on the upper third of the temporal ridge, about 2.5 cm below the base of the horn.

e- Auriculopalpebral block. (Cattle and horses) Auriculopalpebral nerve supplies motor fiber to the orbicularis oculi muscle. It runs from the base of the ear along the facial crest, past and ventral of the eye, giving off its branches on the way, The needle is inserted in front of the base of the ear

at the end of the zygomatic arch and is introduced until its point lies at the dorsal border of the arch. 2% lidocaine 10-15 ml at injection site.

f- Anesthesia of the limbs (Horse and cow) In the horse, very specific nerve blocks are used both for diagnoses of lameness and to allow surgery of the lower limb. Intrarticular injections are also used.

g- Brachial plexus block : Brachial plexus block is suitable for inducing analgesia for the surgery on the front limb, any area below distal part of humerus. The technique should be performed in a well-sedated or anesthetized animal. This block can be used in dogs, cats, small ruminants, calves, and foals. Brachial plexus block is relatively simple and safe to perform and produces selective anesthesia and relaxation of the limb and analgesia to the forelimb. This technique places a local anesthetic in close proximity to brachial plexus nerves that include the radial, ulnar, median, musculocutaneous and axillary nerves.

Local Anesthetic Toxicity

When careful technique and appropriate dose are used, local anesthetics are relatively free of harmful side effects. However, as with any pharmacological agents, local anesthetics may cause severe toxic reactions after unintentional intravenous administration, vascular absorption of an excessive dose (large volume or high concentration) of the local anesthetic agent, or ingestion
of topical local anesthetic preparations. Doses of local anesthetics, especially those for cats and small dogs, should always be carefully calculated and reduced in sick
animals. For example, in healthy dogs and cats, the dose of lidocaine should not exceed 12 and 6 mg/kg, respectively, to prevent toxicity. Repeated applications, the application of higher than the recommended doses, or impaired elimination may all contribute to increasing blood concentration of local anesthetics. Potential
damage may also occur from chemical contamination of the local anesthetic solution, allergic reactions, or methemoglobinemia, or from neural ischemia produced by local pressure or hypotension. The systemic toxicity of local anesthetics involves primarily alterations in the CNS and the cardiovascular system.

Muscle Relaxants

Analgesia

Analgesics are pain relievers most often given after a surgery. Narcotic analgesics have already been described above. Nonsteroidal antiiflammatory drugs (NSAIDs) may also be used for their analgesic effect. The NSAIDs consist of drugs like aspirin, ketoprofen, acetaminophen, flunixin and ketorolac. There are a large number of these drugs available, however, relatively few are used in animals. NSAIDs are, in general, less potent analgesics than are the narcotics. However, in specific instances they can have similar activity.

The advantages of the NSAIDs are that they do not cause sedation nor are they addictive as are the narcotic analgesics. There are no special recordkeeping requirements. In addition, they are more effective against pain caused by inflammation, such as is seen with tissue repair, orthopedic surgery, infection and injury. One disadvantage of the NSAIDs (or any other analgesics) when given to the animal for oral self-administration (e.g. in drinking water, juice, treat food, etc) is that the physiological disturbances caused by an anesthetic episode may significantly decrease an animal's willingness to eat or drink during the immediate post-procedural period. This effect is independent of the level of invasiveness of any surgical procedure. To alleviate pain from surgical procedures, some form of parenteral analgesia should be given prior to anesthetic recovery and should be continued for a minimum of 12-24 hours after the animal has regained consciousness. The NSAIDs have several side-effects related to their pronounced anti-prostaglandin (anti-cyclooxygenase and in some cases lipooxygenase) activity. This is peripheral with most drugs, but is primarily central with acetaminophen. These effects can alter immune function, platelet function and can cause gastrointestinal ulceration. In addition, the NSAIDs all have the potential to cause nephro- and hepatotoxicity. This is variable among species. Cats, in particular, are sensitive to the NSAIDs.

Sedatives and tranquilizers

Sedatives and tranquilizers are used to relax an animal for procedures such as trimming nails, taking x-rays, or drawing blood. These medications are injected either into a muscle or directly into a vein. Sedatives and tranquilizers are commonly used in combinations as preanesthetics before general anesthesia to relax and sedate the animal.

Diazepam (Valium) and midazolam are tranquilizers that are used to relax animals before surgery. They should not be used in pregnant animals, since they could cause birth defects. Acepromazine is another tranquilizer used as a preanesthetic. It should not be used in animals that have seizures, since it may increase the risk of the animal having a seizure. It may also cause *hypotension* (low blood pressure). Tranquilizers do not provide analgesia (pain relief).

With any of these medications, the animal may be groggy for the remainder of the day, but should be able to stand and walk before he is allowed to go home.

Phenothiazine and Buterophenone Sedatives

These sedatives include acepromazine, chlorpromazine, droperidol (Innovar-Vet) and azaperone (Stresnil). These drugs have excellent sedative properties, as well as muscle relaxation, antiemetic and antiarrhythmogenic effects. They have no analgesic activity, but when administered with other anesthetics can potentiate their effect. Acepromazine is the most commonly used. It is recommended as a sole sedative in dogs and as an anesthetic premedication to improve both induction and recovery (it is long acting) in all species. Droperidol is usually only available in combination with the narcotic, fentanyl (Innovar-vet) and has been associated with aggressive behavior in dogs.
Disadvantages of these sedatives are that they are alpha adrenergic blockers and cause peripheral vasodilation which can lead to hypothermia.

Benzodiazapines

The benzodiazapines include diazepam (Valium), midazolam (Versed) and zolazepam (Telazol). These drugs are anti-anxiety and anticonvulsant drugs with good muscle relaxation. They have minimal cardiovascular and respiratory effects. Sedation is minimal in most species, except for swine and nonhuman primates. The primary use of these drugs in

anesthesia is in combination with other drugs. Ketamine-diazepam, midazolam-narcotic, and tiletamine-zolazepam (Telazol) combinations can be very useful for induction of general anesthesia and for short procedures. These drugs are regulated by the Controlled Substances Act and require special record keeping.

Thiazines

The thiazine derivatives include xylazine and medetomidine. These two drugs are very similar. They are alpha-2 adrenergic agonists. They cause CNS depression resulting in sedation, emesis and mild analgesia. They also cause hypotension, second degee atrio-ventricular block and bradycardia. Occasionally, aggressive behavior changes have been seen in dogs. They are very useful in combination with other drugs, like ketamine for anesthesia in rodents and swine. They are best avoided in dogs, cats and nonhuman primates, primarily because their significant side-effects can be avoided by using other drugs. They can be used alone for minor procedures in ruminants. It is important to note that the dose for these drugs in ruminants is 1/10 that used in other species. The effects of the thiazine derivatives can be reversed with yohimbine or atapimazole. Use of these drugs with the reversal agent shortens anesthetic recovery and greatly expands the safety and utility of these drugs. Xylazine is a potent analgesic in frogs appropriate for relief of post-surgical pain.

Opiates

The opiates, sometimes referred to as narcotics,are a large class of drugs that exert their effects on the opiate receptors in the central nervous system. Depending on the receptors a drug is active against, and the type of action it has on the receptor, the effects of narcotics can be primarily analgesic, as with buprenorphine (Buprenex), pentazocine (Talwin) and nalbuphine (Nubain), or a mixture of analgesia and euphoria with sedation as with butorphanol (Torbugesic), fentanyl (Innovar-Vet), morphine, meperidine (Demerol) or oxymorphone. Opiates have little effect on the myocardium. However, there can be significant respiratory depression, as well as other side-effects such as nausea and vomiting, delayed gastric emptying, hypotension, and bradycardia. Some species may develop hyperexcitability if given certain opiates. These side-effects are seen more with the mixed effect opiates than the pure analgesics. Naloxone is a opiate antagonist that can be used to reverse the effects of other narcotics. Other opiates, like buprenorphine, nalbuphine and nalorphine, have mixed agonist-antagonist effects and may interfere with

the effects of concurrently administered narcotics. All opiates are controlled substances and their use requires special record keeping

Barbiturates

The barbiturates are an acid ring molecule with various ring substitutes that imbue the drug with different properties. Barbiturates are also considered narcotics.
Phenobarbital is the longest-acting of the barbiturates. Its use is limited primarily to sedation or as an anticonvulsant.
Pentobarbital is a short-acting oxybarbiturate. It is usually used as a sole anesthetic agent, or is supplemented with an analgesic.When given intravenously, about 50-75% of the calculated dose is administered
Thiopental and Thiamylal are thiobarbiturates that are considered ultra-short acting. Similar to these is methohexital which is an oxybarbiturate. Because of the extremely short duration of activity (up to 10 min with methohexital, up to 15-20 min with thiopental or thiamylal) of these drugs, they are usually used as an intravenous anesthetic induction agent to allow intubation prior to use of inhalant anesthesia ***Effects and Side Effects*** In general the barbiturates cause generalized central nervous system depression, which can be dosed to provide sedation or general anesthesia. The drugs also have an anticonvulsant effect. Analgesia provided by the barbiturates is poor and a relatively deep plane of anesthesia is required for surgery, unless used in combination with analgesics. The barbiturates have significant cardiopulmonary depression,

General Anesthesia

Anesthesia is a state of unconsciousness induced in an animal. The three components of anesthesia are *analgesia* (pain relief), *amnesia* (loss of memory) and *immobilization*. The drugs used to achieve anesthesia usually have varying effects in each of these areas. Some drugs may be used individually to achieve all three. Others have only analgesic or sedative properties and may be used individually for these purposes or in combination with other drugs to achieve full anesthesia.

Curariform skeletal muscle relaxants or neuromuscular blockers (*e.g. succinylcholine, decamethonium, curare, gallamine, pancuronium*) are not anesthetics and have no analgesic effects. They may only be used in conjunction with general anesthetics. Normally, artificial respiration must be provided. Physiologic monitoring methods must also be used to assess anesthetic depth, as normal reflex methods will not be reliable.

It is important to realize that anesthesia is not a simple thing. It has profound effects on an animal's physiology because of the generalized central nervous system effects as well as specific effects on all other body systems. Thus, while anesthesia is necessary to prevent pain or distress in research animals, it must not be ventured into lightly. It is important to learn about the drugs you will be using and about the physiology of the animal you will be monitoring.

Stages of Anesthesia

These stages occur (when using inhalation anesthesia alone; other drugs added will modify these stages.

Stage 1 (Induction, aka voluntary excitement). Excitement and struggling are common. Usually accompanied by ephinephrine release with associated rise in respiratory rate and heart rate.

Stage 2 (delirium, involuntary excitement). Voluntary centers and loss of consciousness begin. Exaggerated reflexive responses to stimuli are common, as is vomiting (in species that can vomit). Breath holding may occur. Common hazard: self-injury.

Stage 3 General Anesthesia

- Plane 1—Light anesthesia. Most reflexes (pedal, corneal, palpebral) are still present.
- Plane 2 – Medium anesthesia. Most surgeries are conducted at this level. Muscles are relaxed. Most reflexes (pedal, palpebral, corneal) are absent.
- Plane 3—Deep anesthesia. Intercostal muscles are relaxed; ability to maintain respiration is endangered. Pupillary light reflex may be slow or absent.
- Plane 4—Too Deep. All muscles, including diaphragm & intercostal muscles, are paralyzed.

Stage 4 Irreversible Anesthesia—respiratory arrest, followed by circulatory collapse. Death within 1-5 minutes.

Stages of Anesthetic Recovery

Recovery Stage 4- Animal is unconscious or semi-conscious and in lateral recumbency. Some reflexes are still diminished or absent. In RAR's Post-Operative Care program, the animal is monitored closely until it has passed through these recovery stages. For animals in Stage 4, it is standard procedure to assess body temperature, heart rate & rhythm, pulse, respiratory rate and character, capillary refill time and state of hydration at least every two hours. The condition of the surgical site is monitored, and analgesics are administered when the animal becomes semi-conscious.

Recovery Stage 3- Animal is conscious and all reflexes are present, but may not be able to control its body position. The swallow (gag) reflex is present, and the endotracheal tubes (if used) can be removed. In Post-Op, the animal is still being closely monitored. The parameters listed above are assessed, but less frequently- approximately every 8-12 hours. Analgesics are continued.

Recovery Stage 2- Animal can either maintain itself in a sternal position, or can stand and move about, but may still show some sedation, ataxia, hypothermia or dehydration. In Post-Op, the parameters listed above, as well as attitude, activity, food and water consumption, are assessed at least every 12 hours.

Recovery Stage 1- All functions are normal, unless altered directly by the experimental procedure. In Post-Op, the animal is monitored every 12 hours for the parameters listed above.. When there are no clinical problems, or signs of pain, discomfort or distress, the animal can be discharged from RAR's Post-Operative Care program.

Balanced Anesthesia

In general, by mixing anesthetic and analgesic drugs, the dose required for each individual drug is reduced, sometimes quite dramatically. Start at the low end of the dose range listed; you can always give more if needed! Drugs not listed below can be mixed using the same concepts, mix a sedative or hypnotic with an analgesic. Do not mix drugs in the syringe until you have determined that they are compatible when mixed.

Ketamine/Diazepam: Mix drugs 1:1 by volume and administer 0.1 ml/kg IV for restraint, anesthetic induction or for non-painful procedures. This gives excellent muscle relaxation, has minimal respiratory or cardiovascular depression and the animals wake up smoothly and quickly (within 10-15 min). Visually, these drugs do not appear to mix completely. When combined and administered as described, the dose is 5 mg/kg ketamine and 0.25 mg/kg diazepam.

Ketamine/Acepromazine: Mix 10 mg acepromazine (1 ml) with 1 g (10 ml) ketamine and give 0.1-0.3 ml/kg mixture IM or IV (up to 0.6 ml/kg in rodents and rabbits). Good for restraint, but not for painful procedures. When combined and administered as described, the dose is 0.09-0.27 mg/kg acepromazine and 9-27 mg/kg ketamine.

Acepromazine/Butorphanol: Mix drugs 1:1 by volume (using 10 mg/ml butorphanol) and administer at 0.01-0.02 ml/kg IV or IM. Creates a hypnotic state that is good for restraint and minor procedures that cause some pain. When combined and administered as described, the dose is 0.05-0.1 mg/kg butorphanol and 0.05-0.1 mg/kg acepromazine.

Ketamine/Acepromazine/Butorphanol: Mix 10 mg acepromazine (1 ml), 10 mg butorphanol (1 ml) with 1 g (10 ml) ketamine and give 0.1-0.3 ml/kg of mixture IM or IV (up to 0.6-0.8 ml/kg in rodents and rabbits).

Good for restraint and moderately painful procedures. More cardiac and respiratory depression will be seen with this mixture than with ketamine alone. When combined and administered as described, the dose is 8-25 mg/kg ketamine, 0.08-0.25 mg/kg acepromazine, and 0.08-0.25 mg/kg butorphanol. For rodents & rabbits, the dose is 50-67 mg/kg ketamine, 0.5-0.7 mg/kg acepromazine, and 0.5-0.7 mg/kg butorphanol.

Ketamine/Xylazine: Good for restraint and painful procedures. Administer IM, IP, or IV. More cardiac and respiratory depression will be seen with this mixture than with ketamine alone. Use 100 mg/ml ketamine and 100 mg/ml xylazine to create any of the mixtures listed below.

General consideration

-Circulation: to ensure that blood flow to the tissues is adequate.

-Methods: Heart rate, Palpation of peripheral pulses, ECG, auscultation of heartbeat, non-invasive or invasive blood pressure monitoring.

-Oxygenation: to ensure adequate oxygen concentration in the animals arterial blood.

-Methods: observation of mucous membranes color and CRT, pulse oximetry, blood gas analysis

-Ventilation: to ensure that the animals ventilation is adequately maintained.

-Methods: respiratory rate, observation of thoracic wall movement or breathing bag movement if animal is spontaneously breathing, ascultation of breath sounds, respiratory monitor, capnography, blood gas monitoring.

Anesthesia Risk or Emergencies

1-Human Errors

• Miscalculation of the drug dose; getting one decimal wrong can mean ten times of overdose that may induce severe toxic effect

• Mislabeling of the syringe, misfiling to a wrong vaporizer etc. may constitute severe hazard

• Equipment failure or misused devices; most notably delivery of hypoxic mixture to the patient

• Exercise precautions to avoid human induced medical mishaps

2- Bradycardia

• As a general rule, for heart rates < 60 beats per min in dogs, and < 25 beats per min in adult horses

3- Tachycardia

Cause

• Light anesthesia

• Drug induced/iatrogenic; atropine, glycopyrrolate

• Hypotension-reflex tachycardia

• Hypercapnia induced sympathetic drive

4- Hypotension

Causes

• Anesthetic overdose

• Hypovolemia due to intra-operative bleeding or peri-operative fluid deficit

5-Premature Ventricular Contractions (PVC's or VPC's)

Cause

• Usually acidemia, hypoxia or hypercapnia

• Pain

• Myocardial contusion from trauma, usually peak at 24 hours following the accident

• Gastric dilitation/volvulus (GDV) syndrome in dogs - peak frequency occurs following surgery

• Sympathetic imbalance

• Drug induced – thiopental (bigeminy), halothane (decrease arrhythmogenic threshold)

6- Perivascular Injection

Causes

• Displaced catheter, no use of catheter for drug administration, leaky vessels

• Use of irritant agents such as thiopental or guaifenesin

7- Brachycephalic Problems

Anatomical handicaps

• Stenotic nares

• Elongated soft palate

• Everted laryngeal ventricles

• Hypoplastic trachea-select several sizes of endotracheal tubes, select smaller size ET tube than non-brachycephalic dogs

• Large thick tongue

8- Cardiac Arrest

Common Causes

• ***Deficiency of oxygen is the ultimate cause of all cardiac arrests.***

• Respiratory failure

• Acid-base disturbances

• Electrolyte imbalances

• Autonomic imbalances

• Hypothermia

• Air embolism

• Toxicity

• Anaphylactic reactions

• Drug overdose~

• Cardiac disease, arrhythmias

Monitor cardiopulmonary function and body temperature-

As an animal becomes too deeply anesthetized, respiration and cardiac output decrease, resulting in poor blood oxygenation and tissue perfusion and decreased blood pressure and temperature.

Anesthetic Emergency Drugs	**Dose (mg/kg)**	**Indications**
Doxopram (Dopram)	1-5 IV (10x in farm animals)	Respiratory stimulant, for complete respiratory arrest only, use with CPR
Furosemide (Lasix)	2- IV, IM	For pulmonary edema. Administer as needed
Naloxone (Narcan)	0.04 IV	For reversal of narcotic sedation or respiratory depression
Yohimbine	0.1-0.15 IV	Reversal of xylazine or detomidine sedation
Atropine	0.02-0.04 IV	For bradycardia
Epinephrine (1:1000)	0.1 ml/kg IV, IT, IC, IM	For cardiac arrest only. Administer IV, intratracheal or intracardiac and perform cardiac massage
Lidocaine	2, IV (0.5 mg/kg in cats)	For diagnosed ventricular tachycardia only. Administer to effect and monitor