

GENERAL CONSIDERATIONS OF ANESTHESIA

Dr. ADARSH KUMAR

INDICATIONS FOR ANESTHESIA

1. Surgical procedures
2. Cervical, spinal and pelvic radiographs
3. Cast applications
4. Obstetrical problems
5. Special diagnostic procedures
6. Others
 - It must be remembered that no one anesthetic agent or technique is the best and the choice depends on several variables.
 - Since anaesthesia is a reversible process, one must be aware of the factors that produce and modify anaesthesia. The dose and technique of administration are based on an average animal. One must adjust the dose according to the patient. Marked variations in response to a standard dose of an anaesthetic result from the reciprocation of many factors. The detoxication process of the patient depends mainly upon the conditions affecting the metabolic rate, which exert a marked influence on anaesthetic effect.

The wide variation in response to standard dose of anaesthetic mainly is related to

1. Basal metabolic rate of animal (BMR), and
2. Uptake and distribution of anaesthetic.

The following factors must be considered before giving anesthesia:

1. The nature of operation, its magnitude, site and duration.
2. Species of animal.
3. Variable reaction of different species and individuals to anaesthetic, and
4. Factors which increase susceptibility to toxic actions of anaesthetics.

1. Nature of operation; its magnitude, site and duration:

- i. Local infiltration analgesia is sufficient for incising an abscess or haematoma or suturing a wound.
- ii. On the other hand a simple condition like equine capped knee can not be removed under local infiltration analgesia since the drug will not be absorbed by the indurated tissues. This requires general anaesthesia.
- iii. Site of operation: General anaesthesia is required for a simple operation like opening a retropharyngeal abscess in equines.

- iv. Duration of operation: Operations of short duration are done under ultra short acting barbiturates; while operations of long duration are performed under long acting barbiturate anaesthesia.

2. Species of animal:

The general rule is that the larger the animal the greater is the difficulties and dangers associated with the induction and maintenance of general anaesthesia. Mainly consider the size, temperament, and anatomical and physiological peculiarities of the species or breed.

i. EQUINES:

Even simple handling provoke excitement, hence restraint is essential. Casting a fully conscious animal involves dangers of fractures, unless an experienced team is available. Of late muscle paralyzing agents are used to cast an animal. In horses it is necessary to provide adequate restraint, even for simple anaesthetic interferences. The casting may be necessary for the safety of the operator as well as the patient.

Simple operations of limbs can be done in standing animal by nerve blocks. When a general anaesthesia is to be used, consider the following:

- a. Induction should be rapid without excitement.
- b. Recovery from anaesthesia should be rapid.
- c. Animal should stand early without floundering or falling.

These pre – requisites forces anaesthetist not to use some sedatives, and slow acting non-volatile anaesthetics. However, horses are good subjects for general anaesthesia.

ii. RUMINANTS (cattle, sheep and goats)

These are not good subjects for general anaesthesia unless endotracheal intubation is done. Regional anaesthesia has attained greatest development in these animals. Major abdominal operations can be done satisfactorily by paravertebral or lumbar epidural injections. Caudal epidural analgesia is extensively used for obstetrical operations. Light general anaesthesia with intravenous agent is enough. Cattle and sheep without the use of endotracheal tube are poor species for inhalation anaesthesia. Likewise, the use of morphine in cat is contraindicated, as it is excitatory to them.

iii. PIG:

Handling and restraint of animal produces struggling and continuous squealing. This makes operator to adopt general anaesthesia. Pig is a good subject for general anaesthesia with sedatives, followed by inhalational or intravenous anaesthetics. Piglets can be operated under local infiltration.

iv. CANINES:

Maximum perfection of general anaesthesia has attained in dogs. General anaesthesia is used for all surgical interferences including examination of mouth, abdominal palpation and radiography. In Brachycephalic dogs (bull, dog and Pekingese), with nasal bone depression, general anaesthesia is bad as relaxed jaw muscles causes obstruction.

Moreover the relaxed tongue falls back on larynx. This can be avoided by using endotracheal intubation. Particular care is needed while using agents that produce slow recovery from anaesthesia.

3. Variable reaction of different species and individuals to anaesthetic:

- a. Cats under large doses of morphine, when stimulated become maniacal.
- b. Horses given sub / anaesthetic doses of barbiturates, when stimulated exhibit marked excitement.

4. Factors that cause increased susceptibility to toxic actions of anaesthetics:

- a. Prolonged fasting depletes liver glycogen. This reduces the detoxifying power of liver. One has to take care while using non-volatile agents even in computed doses, since there is risk of increased susceptibility.
- b. Diseased conditions:
 - i. Toxaemia produces degenerative changes in liver and myocardium. More care has to be taken while using non-volatile agents. Thus, toxaemic animals require much less dose.
 - ii. Wasting disease produces tachycardia and a soft, friable myocardium. Such animals may develop cardiac failure due to anaesthetic stress.

FACTORS AFFECTING ANESTHESIA AND SEDATION OF ANESTHETIC TECHNIQUE

1. Age of the patient:

Neonatal----- Maturation

Geriatric-----Degeneration

These factors modify the response to anesthesia.

2. Size of the patient:

Small anI/Mal has higher basal metabolic rate than large anI/Mal so large dose is required in them.

3. Physical condition of the anI/Mal :

AnI/Mals with large quantities of fat which is relatively inactive non metabolizing tissue have a lower basal metabolic rate per unit of body weight and require less anesthetic than lean muscular anI/Mal in good condition. Greyhounds, an example of the latter are notorious for their tendency toward excitability during induction and for a prolonged period of recovery.

4. Sex :

The basal metabolic rate of males is approx. 7% higher than that of females. In the females rise occurs during pregnancy due to the metabolic activity of the fetuses.

5. Genetic differences:

Genetic variation in dose response to anesthetics has been reported.

6. Temperament, activity and biological rhythm:

Active animals have high BMR -----High doses.

FACTORS MODIFYING UPTAKE, DISTRIBUTION AND ELIMINATION OF ANESTHETICS:

1. Rate of administration and concentration of anesthetic agent:

Concentration and rate of injection of a given dose effect anesthetic action, particularly with short acting barbiturates. The more dilute the agent and slower the injection, the less effect is produced.

2. Respiratory Function :

Modification of effective ventilation, ventilation perfusion ratios and/or alveolar capillary diffusion from any cause will influence both the uptake and elimination of inhalant drugs, more especially those of greater solubility. E.g., Diaphragmatic hernia, pulmonary edema, pulmonary emphysema or atelectasis, and recumbency in large animals.

3. Circulatory function:

Variation in distribution of blood to the vessel rich and vessel poor tissues, to fat, to muscles and to the alveoli themselves will modify the pattern of induction and recovery.

- In shock cardiac output flowing to the brain increases, so potential for redistribution is reduced.
- If reduced blood volume is there—dilution of drug is also diminished---, as is hepatic and renal blood flow---Thus decrease bio-transformation and renal excretion so Induction is rapid and recovery is delayed and dose required is less.
- Removal of 2% of body weight may prolong the recovery time from thiopental anesthesia.
- Hemorrhages during surgical procedure can increase sleeping time.
- Fear, struggling or fever increases the blood flow to skin and muscles and induction of anesthesia is delayed and more anesthetic is required and the decrease in circulation time will delay the equilibration of anesthetic concentration between the alveoli and pulmonary capillaries. For this preanesthetic is recommended to prevent overdosing.

4. Recent feeding:

A. Starvation has three major effects

- a. Reduced circulating fatty acids
- b. Low plasma glucose
- c. Mobilization of liver glycogen

These all may alter drug detoxification rates.

B. Feeding—Has three effects

- a. alters the metabolic rate
- b. Increases chylomicrons in blood and thiobarbiturates localizes in them thus duration of anesthesia is shortened
- c. Increases blood flow to the abdominal viscera and influence anesthetic distribution

5. Uptake in gas spaces:

-Nitrogen is the major constituent of closed internal body spaces and it has high blood/gas partition coefficient relative to nitrogen and other gases of the intestinal tract. So the Nitrous oxide is transferred to internal gas spaces and leads to increased volume and pressure within these spaces (intestinal, peritoneal and thoracic, sinuses and middle ear). So use of nitrous oxide is contraindicated in pneumothorax, pneumoencephalogram, intraocular surgery and intestinal obstruction requiring prolonged anesthesia.

6. Solubility of inhalant anesthetic in rebreathing bags and hoses:

Methoxyflurane and halothane has a tendency to be absorbed in the rubber system thus delays the rise and fall of anesthetic tension within the system and induction and recovery is influenced.

7. Changes in blood constituent:

-Most Non inhaled drugs are weak acids (Barbiturates) and weak bases like (narcotics, narcotic antagonists, muscle relaxants). Once the drug is injected equilibrium between ionized and non-ionized forms of drugs depends upon pH of the blood or tissue and the dissociation constant (pKa) of the drug. So the difference in pH between tissue and blood may thus result in a drug concentration difference.

-Drug availability at the site of action or of elimination is modified by the degree of protein binding and protein binding is diminished by uremia, hypoproteinemia and by the drugs competing for the binding sites or by dehydration or disease. Such decreased binding may take more drug available for specific action with consequent apparent sensitivity to normal dose.

8. Preanesthetic medication and previous administration of drugs:

- Opioid analgesics lower the metabolic rate, atropine causes a slight rise. So when they are administered together in combination, the metabolic rate however is reduced.
- Tranquilizers lower the metabolic rate.
- Some drugs or pesticides stimulate (Enzyme induction) or inhibit (Enzyme inhibition) hepatic microsomal drug metabolizing enzymes

Enzyme inducers are Hypnotic, barbiturates, ethanol, chloral hydrate

Tranquilizers- Chlorpromazine, promazine, Chlordiazepoxide.

Anticonvulsants - Diphenylhydantoin

Antihistaminics- Diphenhydramine

Steroids- cortis\ones, Prednisilone

Anesthetics-Diethyl ether, Halothane

Insecticides- DDT, Chlordane

The nature of induction varies with the type of drug, its dose, age, thyroid function and genetics. Enzyme induction leads to accelerated biotransformation—which reduces the pharmacologic activity of drugs which are normally eliminated by biotransformation. Such as certain barbiturates, tranquilizers, hypnotics and anti-inflammatory agents and certain inhalant anesthetics. This effect has little significance on clinical anesthesia, but it is of significance in relation to viscerotoxicity. E.g. Methoxyflurane-----E induction-----Nephrotoxic metabolites. and Chloroform-----Enzyme induction----- hepatotoxic metabolites.

Enzyme Inhibitors: Organophosphorus insecticide, pesticides, guanidine, CCl₄, chloramphenicol, tetracyclines produces inhibition of hepatic microsomal enzymes thus prolongs the plasma half life of barbiturates, narcotics and local anesthesia during halothane anesthesia.

Drug interaction: Can occur because of protein binding and interaction at receptor site. Mainly antibiotics—They cause neuromuscular blockade and intensify effects of nondepolarizing Nm blocking agents, or they may interact with each other.

<u>Antibiotics</u>	<u>General anesthetics</u>
Bacitracin, streptomycin, Dihydrostreptomycin, Neomycin, Kanamycin, Gentamycin, Polymixin, Oxytetracycline.	Ether, halothane, methoxyflurane
	<u>Other agents</u>
	MuS/Cle relaxants, Quinine, promethazine, Magnesium sulphate, barbiturates, Oganophosphrous

9. Concurrent disease:

-If early febrile stage----Metabolic rate Increases

-If disease progress—Toxemia---Metabolic rate decreases.

-Each Fahrenheit rise----increases 7% the BMR

-Liver disease/toxemia---Impairs detoxification of anesthetics

-Shock---lowers the metabolic rate and because of suppressed cardiovascular function leads to I/Impaired uptake and distribution.

-Renal disease---distribution and elimination is disturbed thus increases the risk of potential toxicity

e.g. -Uremia--- It increases the sensitivity of pentobarbital, phenylbutazone etc.

-Hyperthyroidism--- increases BMR

-Hypothyroidism----lowers BMR

-Leukemia---- increases

10. Ionizing radiation and anesthetic effects:

X- irradiation effects on

- a. Potency, onset, duration of action, brain levels of barbiturate by affecting the activity of hepatic microsomal enzyme system.
- b. Earlier onset of drug action apparently results from radiation induced modification of the BBB. In adult animals ---prolongation of drug action occurs because of sensitization with region specific increase in brain serotonin and partial inhibition of hepatic oxidase.



Geriatric Anesthesia

The geriatric period includes:

Dogs and cats over 10 years of age

Horses over 15 years of age

Or, consider the geriatric period to be the last 20% of the anticipated life-span of the animal.

In these animals there is a reduced ability to deal with the detoxification of administered drugs and there are limited reserves to deal with the stress of anesthesia. The preanesthetic 'work-up' is important and should be as thorough as possible. The cardiopulmonary, hepatic and renal systems should be especially evaluated. Use short-acting, easily eliminated drugs at the low end of the dose range. Use balanced anesthesia techniques to avoid using higher doses than is necessary of major depressant drugs. Avoid periods of hypoxia/ hypercarbia/ hypotension and hypothermia (this is true for any anesthesia, but is especially important in geriatrics).



Cesarean Section

The following is a quick review of the physiology of the pregnant animal:

- Cardiac output is increased to meet extra demands and this leaves less reserve to cope with the stresses of anesthesia.
- Blood volume increases more than the red cell mass therefore a physiological anemia is present.
- Ventilation is increased to cope with the reduced functional residual capacity and the extra demands for oxygen. This can increase the rate at which inhalation agents are taken up.
- Gastric motility is reduced and there may be ingesta in the stomach at the time of induction. This leads to an increased risk of regurgitation and aspiration of gastric contents into the pulmonary system. Cats and dogs usually go off feed sometime before delivery. Owners often enquire whether they can offer food to the mother during parturition. It is probably best to advise glucose-water instead, in case there are subsequent difficulties which require an anesthetic to be administered to the patient.