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ANAESTHESIA IN LABORATORY ANIMALS

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ABSTRACT

Anaesthesia and analgesia are imperative components in laboratory animal science and these should be incorporated as essential components in all laboratory animal training programmes. It prevents unnecessary pain induced by various experimental procedures(Flecknell, 1993). The uncontrolled or unattended pain can create stress in an animal which creates release of uncontrolled substances. Finally it can lead to a series of unwanted changes in its body. Ultimately, this will influence the experimental outcome. Because of these reasons, the rational use of anaesthesia and analgesia is an ethical and a scientific requirement(Mcintyre, 1971).

Anaesthesia is a state of unconsciousness and the component of anaesthesia is analgesia (pain relief), amnesia (loss of memory) and immobilization. The drug used to achieve anaesthesia usually has varying effects in each of these areas. Some drug may be used individually to achieve all three effects. Others have only analgesic or sedative properties(Whelan & Flecknell, 1992).

Keywords: Anaesthesia, Anaesthetic, Restraining, Drugs

INTRODUCTION

Anaesthesia is widely used in animals as their inability to co-operate with certain procedures such as treatment or disease diagnosis. It can be simply defined as loss of sensation in animal to painful stimuli with or without loss of consciousness(Flecknell, 1993). The main purpose of providing anaesthesia is to immobilize the animal and prevent the perception of painful stimuli while maintaining physiological functions of the animal as normal as normal as possible.

Good anaesthetic drug provides smooth induction and recovery of animals that reduce salivary and bronchial secretion and reduce pre-operative pain in animal. An anaesthetic agent which gives shorts duration of anaesthesia provides half to one hour duration of anaesthetic effect(Cicero et al., 2018).

Narcosis, muscle relaxation and analgesia are three main classical components in anaesthesia. It is necessary to anaesthetize laboratory animals before painful procedures such as cardiac puncture, retro-orbital bleeding or surgery. If a researcher is good in anaesthesia and knowledgeable it will reduce significant amount of stress and pain to the animals. One may deliver anaesthetic agent either through inhalation or injections(Regimen, n.d.).

1.1 Objectives of Anaesthesia

- To perform some surgical intervention for research proposes
- Obtain physiological stability for the procedures
- Restore the normal physiological function after intervention is over
- To prevent pain & distress during the procedure
- To provide immobility (keep the catheter etc.)
- To provide suitable condition for surgery (Muscle relaxation)

1.2 Components of General Anaesthesia

1. Loss of consciousness (hypnosis)
2. Loss of sensory function (analgesia)
3. Muscle relaxation
4. Suppression of reflex activity

2. PRE ANESTHESIA OR PRE MEDICATION

Pre - anesthesia or pre- medication helps both the anesthetist and the animal and it makes the induction and maintenance of anesthesia easier for the anesthetist that safer and comfortable for the animal. Pre - medication is usually given before invasive procedures such as surgery, with the main purpose of decreasing fear and in preparation for general anesthesia(*View of Anesthesia Protocols in Laboratory Animals Used for Scientific Purposes*, n.d.).

3. SEDATION

Sedation exertsa calming and quieting effect on animals which reduces locomotor activity and makes them indifferent to the surroundings. Although it reduces body temperature when used as a premedicant before induction of anesthesia and reduces the dose of injectable anesthesia by 20%-50%. Main purpose of pre medication is decrease fear and preparation for general anesthesia(Formularies, n.d.).

4. TYPE OF PRE ANESTHETIC DRUGS

4.1 Anticholinergics

Historically anticholinergics are used in premedication to decrease the salivary and bronchial secretions. These drugs can block parasympathetic stimuli eg: Atropine sulphate, glycopyrolate. Sometimes it is necessary to reduce bronchial secretions to prevent air way obstruction while animal is under sedation(Formularies, n.d.).

4.2 Sedative Anesthesia

It produces more profound degree of sedation with greater drowsiness and block both unconditional (automatic instincts) and conditional (emotions, motives) reflexes. But it has shorter duration of action e.g.: Barbiturates (Phenobarbitone,barbitone) Chloral hydrate, Benzodiazepines (Diazepam) ,Alpha 2 agonists (Xylazine, Detomidine)(Gargiulo et al., n.d.).

4.3 Sedative tranquillizers

Tranquillizers have a calming effect without sedation but they do not have an analgesic action, so the animal will respond to painful stimuli. Sedatives provide drowsiness, reducing fear that

blocks only conditioned reflexes. Arousal reaction on sensory stimuli such as visual, auditory, tactile or painful stimuli can be normal or exaggerated(Formularies, n.d.).
e.g.Phenothiazines(Promethazine,promazine,acepromezine,chlopromazine),Thioxanthines(Chliprothixene)

5. CLASSIFICATION OF ANESTHETIC AGENTS

Laboratory Animal Anesthesia can be broadly classified into:

1. LocalAnesthesia
2. Regional Anesthesia
3. Sedatives or narcosis
4. General Anesthesia by inhalation /parentral

6. PHASES OF ANAESTHETIC DEPTH

Anesthesia can be divided into four phases. But transition from one phase to another is gradual. It is compulsory to monitor the depth of the anesthesia throughout the procedure from induction of anesthesia until recovery.

It is essential to make sure that the animal is anaesthetized enough in order not to feel painful stimuli but it is very important to make sure that it is not over anaesthetized during the procedure. The depth of anesthesia can easily be assessed by observing reflex activity, respiratory patterns and depth, heart rate, blood pressure and reactions to potential noxious (painful) stimuli(Health et al., n.d.).

7. ANESTHETIC MONITORING

Anesthetic monitoring is not only limited to electrical monitoring devices. Muscle movements or voluntary movements, especially in response to painful stimuli can be used to assess the depth of anesthesia. This can be assessed by the response of animal to any painful stimuli. Pain can be expressed by lifting of head, kicking of leg in response to any noxious stimuli such as pinching of a foot pad or digit(Restraint et al., 2019).

Light anesthesia in laboratory animals can be defined as the point at which the animal loses its righting reflex (when the rat is put on its back, it turns over immediately) and is immobilized but can respond markedly to potential painful stimuli(Dadd, 1973).

8. THE VALUE OF ANAESTHETIC MONITORS

Anesthetic devices are available to get important information but it is important to individualize the monitoring strategies in order for better animal monitoring. The Use of electrical anaesthetic devices are good as we can obtain more information about the anaesthesia and Using the electronic devices are no use and does not improve the anaesthetic safety if we don't properly utilize the data(Flecknell, 1993).

9. MONITORING OF REFLEXES

Reflexes are some involuntary movements of the body in response to a stimulus and are mediated by the reflex arch in the spinal cord. The presence of reflexes does not always mean that the animal is feeling pain,some reflexes can persists in surgical plane of anaesthesia while other reflexes have disappeared. Unless it is possible to monitor physiological parameters as in

response to noxious stimuli the only indicators of anesthetic depth are the reflexes of the animal. It is justifiable that an animal with positive reflex is sensitive to pain and not adequately anaesthetized(Mcintyre, 1971).

10. FOUR PHASES OF ANESTHESIA

I. **Induction phase:** The animal is still conscious and experiences a light state of sedation and analgesia.
II. **Excitation phase:** The animal loses consciousness and shows exaggerated reflex activity and mucous secretion.
III. **Surgical phase:** The animal's respiration becomes shallow and deep, the reflexes of the eye-lid and cornea disappear. The reflex response to surgical or other stimuli diminishes.
IV. **Hypnotic or toxic phase:** At this stage, the vital brain centers become depressed and heart function and respiration slow down and eventually cease. The pupils are fully dilated and do not respond to light. This stage can be observed when euthanizing animals by overdosing them with anaesthetic agents.

11. MODE OF ANESTHESIA

- IV- intravenous
- IM- Intramuscular
- IP- Intraperitoneal
- SC- Subcutaneous
- PO- per oral
- IH – inhalation

12. PHYSICAL RESTRAINING OF ANIMALS

Anesthesia induction requires several form of physical restraining methods. Restraint devices are available, but require more time to place the animal into the restraint device than to gently hold the animal. The important point to remember is manual restraint should be brief in order to minimize the pain(Cicero et al., 2018). Accuracy in delivering drugs via intra venous method is essential in anesthesia. Researcher should be competent in the technique to minimize pain and distress to the animal. As such it is essential to know proper anesthesia and intravenous techniques to perform this(Regimen, n.d.).

13. RESTRAINT /PREANESTHESIA

Table 1: Restraint or Preanesthesia of animals(Handling and Restraint of Small Laboratory Animals, n.d.)

Animal type	**Drug**	**Dosage**	**Route**
Guinea pigs	Atropine	0.01mg/100g	IP/IM/SC
	Ketamin	2.2-4.4 mg/100g	IM
	Ketamin and Acetylpromazine	2.2-4.4 mg/100g	IM
	Chlopromazine	0.05mg/10g	IM
Rabbits	Ketamine	15-50mg/kg	IM
	Acetylpromazine	1.0-10mg/kg	IM/SC/IV
	Diazepam(Valium)	5-10mg/kg	IV/IM

	Glycopyrrolate	0.005-0.011mg/kg	IM
	Ketamin/Acetyl promezine(10:1)	15-50mg/kg	IM
Hamsters	Atropine	0.01mg/100g	IP/IM/SC
	Ketamin	2.2-4.4 mg/100g	IM
	Ketamin and Acetylpromazine	2.2-4.4 mg/100g	IM
	Chlopromazine	0.05mg/10g	IM

14. SIGNIFICANCE OF PHYSIOLOGICAL PARAMETERS

Anaesthesia is not a simple thing. Physiological monitoring must be used to assess anaesthetic depth as normal reflex method will not be reliable. It has profound effect on animals physiology, because of generalized central nervous system effect as well as its effect on other body system(Health et al., n.d.).

14.1 Species information of mouse

Physiological parameters:

1. 1.Body temperature - 36.5 ^{o}C – 38.0 ^{o}C
2. 2.Heart rate - 325-780/min
3. Respiratory rate - 94-163/min
4. 4.Tidal volume – 0.09-0.23 ml

14.2 Species information of rats

Physiological parameters:

1. Body Temperature 35.9 o C – 37.5 o C
2. 2.Heart rate – 250-450/min
3. 3.Respiratory rate – 70-115/min
4. 4.Tidal volume - 0.6-2.0ml

- ❖ Male rats and animals receiving a low caloric diet require higher doses of barbiturates.

14.3 Species information of guinea pigs

Physiological parameters:

1. Body temperature - 37.2 ^{o}C – 39.5 ^{o}C.
2. Heart rate - 230-380/min
3. Respiratory rate – 42- 104/min
4. Tidal volume - 2.3 – 5.3ml/kg

- ❖ Large cecum can act as a reservoir for anesthesia. Induction of anesthesia using volatile anesthetics (halothane, isofluorane) should be done with caution.
- ❖ Repeated exposure to halothane can cause hepatotoxicity.
- ❖ Methoxyflurane and isoflurane are safer inhalant anesthetics in Guinea pigs.
- ❖ Ketamin (Innovar vet) given IM can cause severe tissue necrosis in Guinea pigs.
- ❖ It is contraindicated for IM use due to severe myositis at the injection site.
- ❖ Self mutilation has been reported after ketamin administration(Restraint et al., 2019).

14.4 Species information of rabbits

Physiological parameters:

1. Body Temperature - 38.0^{o}C – 39.6^{o}C
2. Heart Rate - 130- 325/min
3. Respiratory rate – 32- 60/min
4. Tidal volume- 4-6ml/kg

- ❖ Many rabbits have serum atropinesterase which cause reduced response to atropine.
- ❖ Glycopyrolate, another anticholinergic can be used instead of atropine.
- ❖ Large caecum can act as a reservoir for anesthesia.
- ❖ Induction of anesthesia using volatile anesthesia (Halothane and isofluorane)should be done with caution.
- ❖ Give IV injections via marginal ear vein(Flecknell, 1993).

14.5 Species information of hamsters

Physiological Parameters

1. Body temperature - 37.0^{o}C – 38.0^{o}C
2. Heart Rate - 250- 500/min
3. Respiratory rate- 35- 135 min
4. Tidal volume- 0.6- 1.4ml

- ❖ Syrian or Golden Hamster is very resistant to morphine and no sedation or hypnotic effect.
- ❖ Syrian or Golden Hamsters has increased tolerance to pentobarbital(*Restraint of Domestic, Laboratory and Wild Animals*, n.d.).

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