Anesthesia and Euthanasia

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Background

- A fundamental responsibility of individuals that use animals in research, teaching or testing is to anticipate and eliminate or minimize any potential that procedures may cause animal pain, distress, or discomfort.
- Although animals that are in pain may not behave like humans,
- (e.g., pain in animals may be accompanied by immobility and silence, in contrast to the groans and cries of human patients),
- it is assumed that procedures that cause pain in humans cause pain in animals.

presence of pain in animals can be recognized

- The by alterations in animal behavior
- (e.g., reduced activity,
- reduced grooming,
- hunched up posture,
- altered gait,
- changes in temperament,
- vocalizations,
- reduced food and water intake,
- reduced urinary and fecal output), and
- in physiological variables, (e.g., reduced depth of respiration, increased heart rate, and reduced hydration status).

Reducing post-procedural/post-operative pain, distress, and discomfort is accomplished by good nursing care, (e.g., keeping the animal warm, clean, dry and well padded), and by the administration of analgesic drugs.

• In addition to the avoidance and alleviation of pain and discomfort, adequate post-procedural /postoperative animal care also includes efforts to prevent and/or treat post-anesthetic complications, (e.g., aspiration, hypostatic pneumonia, cardiovascular and respiratory depression, dehydration, and infection).

• The prevention or minimization of animal pain, distress, or discomfort by the proper use of tranquilizers, anesthetics, and analgesics is scientifically and ethically essential to the humane care, use, and treatment of research animals.

DEFINITIONS:-

• **Neuroleptic** - produces central nervous depression, depression of excitability of the autonomic nervous system, a dulling of consciousness and a reduction of spontaneous motor activity (e.g., tranquilizers/sedatives).

- Analgesia relief from pain.
- Preemptive analgesia managing pain before it begins.

Tranquilization - a state of behavioral change in which the patient is relaxed, unconcerned by its surroundings, and often, indifferent to minor pain.

• Sedation - a mild degree of central depression in which the patient is awake but calm; larger doses of sedative may lead to narcosis

Narcosis - a drug-induced state of sedation in which the patient is oblivious to pain.

• Local anesthesia - loss of sensation in a limited body area.

- **Regional anesthesia** loss of sensation in a larger, though limited, body area.
- **Basal anesthesia** a light level of general anesthesia usually produced by preanesthetic agents; serves as a basis for deeper anesthesia following the administration of other agents.
- General anesthesia complete unconsciousness
- **Surgical anesthesia** unconsciousness, accompanied by muscular relaxation to such a degree that surgery can be performed painlessly.
- Neuroleptanalgesia a state of central nervous system depression and analgesia usually produced by a combination of a neuroleptic and a narcotic analgesic.

Observations before anesthesia

- In order to reduce anesthetic risk and prevent post-anesthetic complications.
- animals must first be examined for signs of disease or distress including, but not limited to,
- ruffled, matted or dull hair coat,
- labored breathing, lack of inquisitiveness,
- failure to respond to stimuli, abnormal posture/positioning,
- dehydration, or impaired locomotion.

Procedure before Anesthesia

 Acclimatizing animals allows them to adjust physiologically and psychologically to their new environment and provides the opportunity to carefully monitor for any abnormalities. Animals should be acclimatized for a minimum of 7 days.

Anesthetic agents in animals

- Commonly used laboratory anesthetics There are numerous anesthetics available for use in rodents. Some of the more popular agents include:
- Chloralose
- Urethane
- Barbiturates
- Paraldehyde
- Magnesium Sulphate
- Ketamine
- Tribromoethanol

EUTHANASIA

The term euthanasia is derived from the Greek terms eu meaning good and thanatos meaning death.

A "good death" would be one that occurs with minimal pain and distress. In the context

• Euthanasia is the act of inducing humane death in an animal.

"Sacrificing the experimental animal after use by gentle procedure causing minimum of physical and mental suffering is called euthanasia (Painless killing).

Objectives of euthanasia

in terms of animal welfare are that the method be painless, achieve rapid unconsciousness and death.

require minimum restraint, avoid excitement, is appropriate for the age, species, and health of the animal,

must minimize fear and psychological stress in the animal,

be reliable, reproducible, irreversible, simple to administer (in small doses if possible) and

safe for the operator, and, so far as possible, be aesthetically acceptable for the operator.

Methods of Euthanasia

• Chemical methods. • Physical methods.

chemical methods

• Inhalant agents:- Ex – ether, halothane, methoxyflurane, isoflurane, enflurane, chloroform, nitrogen, nitrous oxide, carbon di oxide, carbon monoxide, argon, hydrogen cyanide.

• Injectable agents:- Ex – barbiturates, chloral hydrate, ethanol, ketamine, magnesium sulphate, potassium chloride, neuromuscular blocking agents.

Physical methods:-

PENETRATING CAPTIVE BOLT

- EUTHANASIA BY A BLOW TO THE HEAD
- GUNSHOT
- CERVICAL DISLOCATION
- DECAPITATION
- ELECTROCUTION
- MICROWAVE IRRADIATION
- THORACIC (CARDIOPULMONARY, CARDIAC) COMPRESSION
- KILL TRAPS
- MACERATION

ADJUNCTIVE METHODS

- Exsanguination- is the loss of blood to a degree sufficient to cause death.
- **Stunning** is the process of rendering animals immobile or unconscious, with or without killing the animal, when or immediately prior to <u>slaughtering</u> them for food.

• Pithing-

Destruction of the central nervous system by the piercing of brain or spinal c ord, as in vivisection. This is done on experimental animals to render them in sensible to pain and to inhibit controlling effects of the central nervous syste m during research and experimentation.

PENETRATING CAPTIVE BOLT

- A penetrating captive bolt is used for euthanasia of ruminants, horses, swine, laboratory rabbits, and dogs. Its mode of action is concussion and trauma to the cerebral hemisphere and brainstem.
- Advantages the penetrating captive bolt is an effective method of euthanasia for use in slaughterhouses, in research facilities, and on the farm when use of drugs is inappropriate.
- Disadvantages— (1) It is aesthetically displeasing. (2) Death may not occur if equipment is not maintained and used properly.

EUTHANASIA BY A BLOW TO THE HEAD

Euthanasia by a blow to the head must be evaluated in terms of the anatomic features of the species on which it is to be performed. The anatomic features of neonatal calves, however, make a blow to the head in this species unacceptable.

• Personnel performing euthanasia by use of a blow to the head must be properly trained and monitored for proficiency with this method of euthanasia, and they must be aware of its aesthetic implications.

GUNSHOT

- A properly placed gunshot can cause immediate insensibility and humane death. In some circumstances, a gunshot may be the only practical method of euthanasia.
- Advantages—(1) Loss of consciousness is instantaneous if the projectile destroys most of the brain. (2) Given the need to minimize stress induced by handling and human contact, gunshot may at times be the most practical and logical method of euthanasia of wild or free-ranging species.
- Disadvantages—(1) Gunshot may be dangerous to personnel. (2) It is aesthetically unpleasant. (3) Under field conditions, it may be difficult to hit the vital target area

CERVICAL DISLOCATION

Advantages—(1) Cervical dislocation is a technique that may induce rapid loss of consciousness. (2) It does not chemically contaminate tissue. (3) It is rapidly accomplished.

Disadvantages—(1) cervical dislocation may be aesthetically displeasing to personnel. (2) Cervical dislocation requires mastering technical skills to ensure loss of consciousness is rapidly induced. (3) Its use is limited to poultry, other small birds, mice, and immature rats and rabbits.

DECAPITATION-

- It is achieved by swiftly cutting the neck of the animal close to the head, by using a guillotine with a sharp blade.
- Decapitation can be used to euthanatize rodents and small rabbits in research settings. It provides a means to recover tissues and body fluids that are chemically uncontaminated.
- Advantages—(1) Decapitation is a technique that appears to induce rapid loss of consciousness. (2) It does not chemically contaminate tissues. (3) It is rapidly accomplished.
- Disadvantages—(1) Handling and restraint required to perform this technique may be distressful to animals. (2) The interpretation of the presence of electrical activity in the brain following decapitation has created controversy and its importance may still be open to debate.

ELECTROCUTION

Electrocution, using alternating current, has been used as a method of euthanasia for species such as dogs, cattle, sheep, swine, foxes, and mink. Electrocution induces death by cardiac fibrillation, which causes cerebral hypoxia. However, animals do not lose consciousness for 10 to 30 seconds or more after onset of cardiac fibrillation.

Advantages—(1) Electrocution is humane if the animal is first rendered unconscious. (2) It does not chemically contaminate tissues. (3) It is economical.
Disadvantages—(1) Electrocution may be hazardous to personnel. (2) When conventional single-animal probes are used, it may not be a useful method for mass euthanasia because so much time is required per animal.

MICROWAVE IRRADIATION

- Heating by microwave irradiation is used primarily by neurobiologists to fix brain metabolites in vivo while maintaining the anatomic integrity of the brain. Microwave instruments have been specifically designed for use in euthanasia of laboratory mice and rats.
- Advantages—(1) Loss of consciousness is achieved in less than 100ms, and death in less than 1 second. (2) This is the most effective method to fix brain tissue in vivo for subsequent assay of enzymatically labile chemicals.
- Disadvantages—(1) Instruments are expensive. (2) Only animals the size of mice and rats can be euthanatized with commercial instruments that are currently available.

COMPRESSION:

Thoracic (cardiopulmonary, cardiac) compression is used to euthanatize smallto medium-sized free ranging birds when alternate techniques described in these guidelines are not practical.

Advantages—(1) This technique is rapid. (2) It is apparently painless. (3) It maximizes carcass use for analytical/contaminant studies.

Disadvantages—(1) It may be considered aesthetically unpleasant by onlookers. (2) The degree of distress is unknown.

KILL TRAPS

Mechanical kill traps are used for the collection and killing of small, free-ranging mammals for commercial purposes (fur, skin, or meat), scientific purposes, to stop property damage, and to protect human safety.

- Advantage—Free-ranging small mammals may be killed with minimal distress associated with handling and human contact.
- Disadvantages—(1) Traps may not afford death within acceptable time periods. (2) Selectivity and efficiency is dependent on the skill and proficiency of the operator.

MACERATION

Maceration, via use of a specially designed mechanical apparatus having rotating blades or projections, causes immediate fragmentation and death of day-old poultry and embryonated eggs.

Advantages—(1) Death is almost instantaneous. (2)The method is safe for workers. (3) Large numbers of animals can be killed quickly.

Disadvantages—(1) Special equipment is required. (2) Macerated tissues may present biosecurity risks.

Exsanguination

Exsanguination can be used to ensure death subsequent to stunning, or in otherwise unconscious animals.

Because anxiety is associated with extreme hypovolemia, exsanguination must not be used as a sole means of euthanasia.

Animals may be exsanguinated to obtain blood products, but only when they are sedated, stunned, or anesthetized

Stunning

Animals may be stunned by a blow to the head, by use of a nonpenetrating captive bolt, or by use of electric current. Stunning must be followed immediately by a method that ensures death.

• Blow to the head—Stunning by a blow to the head is used primarily in small laboratory animals with thin craniums. A single sharp blow must be delivered to the central skull bones with sufficient force to produce immediate depression of the central nervous system. When properly done, consciousness is lost rapidly

Non-penetrating captive bolt

A non-penetrating captive bolt may be used to induce loss of consciousness in ruminants, horses, and swine.

Signs of effective stunning by captive bolt are immediate collapse and a several second period of tetanic spasm, followed by slow hind limb movements of increasing frequency.

Other aspects regarding use of the non-penetrating captive bolt are similar to the use of a penetrating captive bolt, as previously described

Electrical stunning

• Electrical stunning—Alternating electrical current has been used for stunning species such as dogs, cattle, sheep, goats, hogs, fish and chickens. Experiments with dogs have identified a need to direct the electrical current through the brain to induce rapid loss of consciousness. In dogs, when electricity passes only between foreand hind limbs or neck and feet, it causes the heart to fibrillate but does not induce sudden loss of consciousness. For electrical stunning of any animal, an apparatus that applies electrodes to opposite sides of the head, or in another way directs electrical current immediately through the brain, is necessary to induce rapid loss of consciousness.

Pithing:-

In general, pithing is used as an adjunctive procedure to ensure death in an animal that has been rendered unconscious by other means. For some species, such as frogs, with anatomic features that facilitate easy access to the central nervous system, pithing may be used as a sole means of euthanasia, but an anesthetic overdose is a more suitable method.