I. INTRODUCTION

The aim of anesthesia is to immobilize the animal and prevent the perception of painful stimuli, while depressing the normal physiologic functions as minimally as possible. The use of sedatives, analgesics (painkillers), and general anesthetic agents are required by law (PHS Policy- OLAW and the Animal Welfare Act- USDA), during any procedures written and approved in the protocol. Changes to the use of anesthetics (dose, drug, route etc) can only be made under the direct orders of a CMLAF veterinarian.

Both reflexes and physiological parameters can be used to assess “anesthetic depth.”

Reflexes

Reflexes are an involuntary and nearly instantaneous movements in response to a stimulus and are mediated via the reflex arc in the spinal cord. The presence of reflexes does not require the perception of pain. Some reflexes may persist in the surgical plane of anesthesia while others are obliterated.

Physiological Parameters

Changes in physiological parameters (respiratory rate, blood pressure and heart rate) in response to noxious stimuli indicate that there is perception of pain.

Unless it is possible to monitor physiological parameters in response to noxious stimuli (surgical manipulation) the only indicators of anesthetic depth are the reflexes. It is appropriate to assume that an animal with a positive reflex is sensitive to pain and not adequately anesthetized.

II. SIGNS USED TO ASSESS ANESTHETIC DEPTH

A. Muscle movements/voluntary movement especially in response to noxious stimuli

Procedure: Observe animal in response to stimuli
Assessment: Lifting of the head, kicking or vocalizing indicates that the animal is experiencing pain and is semi-conscious.

B. Jaw Tone

Procedure: Gently open the animal’s mouth.
Assessment: Assess the degree of muscle relaxation. If jaw is relaxed and easy to open, then the animal is adequately anesthetized. If there is resistance, then the animal is too light (not deeply anesthetized).
C. **Swallowing reflex**

**Procedure:** Gently place traction on the tongue

**Assessment:** Chewing and swallowing can be visualized externally, and if seen the animal is too light. When the tongue is not retracted, the animal is adequately anesthetized.

D. **Withdrawal Reflex (Toe, Paw)**

**Procedure:** Extend one leg and pinch the web of skin between the toes with your fingernail to ensure adequate pressure is applied.

**Assessment:** A positive reflex is indicated by the flexion of the limb. If the animal makes general body movements or cries out this is not a reflex response but indicates that the animal has felt the stimulus.

E. **Withdrawal Reflex (Ear Pinch)**

**Procedure:** Pinch the ear.

**Assessment:** A positive reflex occurs when the animal shakes its head or moves its whiskers forward.

F. **Palpebral Reflex**

**Procedure:** Gently touch the medial canthus of the eye (inner corner).

**Assessment:** A positive reflex occurs if the animal blinks.

G. **Corneal Reflex**

**Procedure:** Gently touch the cornea/eyeball with a cotton swab or Q-tip.

**Assessment:** A positive reflex occurs if the animal blinks.

H. **Respiratory Rate (Normal 70-115 breaths/min)**

**Procedure:** Monitor respiratory rate, especially any response to a painful stimulus.

**Assessment:** If the animal is conscious of painful stimuli and too light, the respiratory rate will increase. Animal may gasp.

I. **Heart Rate (Normal 250-450 beats/min)**

**Procedure:** Special equipment is required to monitor rodent heart rate. Rate and response to noxious stimuli are monitored.

**Assessment:** If the animal is conscious of painful stimuli the heart rate will increase.
J. Blood Pressure (Normal 84-134/60 mm Hg)

Procedure: Special equipment is required to monitor rodent blood pressure. Resting pressure and response to noxious stimuli are monitored.

Assessment: If the animal is conscious of painful stimuli the blood pressure will increase.

K. Mucous Membrane Colour

Procedure: Examine eyes, ears, mouth/nose, paws. Press on gum, or nail beds and count # of seconds for the blanched area to return to pink. Blanched area should return to normal pink within 1-2 seconds

Assessment: Areas should be pink. If pale, blue, or gray animal is too deep and near death.

III. ASSESSMENT OF ANESTHETIC DEPTH

A. Too Light

1. Animal is relaxed with loss of awareness. In response to painful stimuli such as a pin prick, animal will move and the physiological parameters will increase (heart rate, respiratory rate, and blood pressure).
2. Jaw is relaxed, and mouth is easily opened.
3. Swallowing reflexes are lost.
4. Withdrawal reflexes are present.
5. Corneal and palpebral reflexes are present.
6. Heart rate and respiratory rate are fast, and will increase in response to pain.
7. Blood pressure can be high due to stress/excitement and/or pain.

B. Surgical Anesthesia

1. Muscles are relaxed and animal is unconscious.
2. Withdrawal reflexes are absent! Try at least 2 toes and the ears so that you are sure that this reflex is absent.
3. Palpebral reflex is lost, but corneal reflex will remain.
4. Respiratory rate is within the normal range (or slightly decreased) and the chest moves up and down in a slow and regular rhythm. If rate increases during surgical manipulation, the animal is not adequately anesthetized.
5. Heart rate is within the normal range. If rate increases during surgical manipulations, the animal is feeling pain, and additional anesthetic should be given.
6. Blood pressure should be at the normal level. If it drops, the animal is going into shock. A pulse in the groin (femoral pulse) is lost at 50 mmHg, and circulation to the kidney, brain and heart are impaired at this point. On the other hand, a rise in blood pressure is indicative of pain perception and the animal should receive more anesthetic.
C. Too Deep

1. Respiratory rate is very slow and well below normal range. Worry if rate becomes less than 60 breaths/minute. Animal is very close to death at this stage. Breathing may stop. Administer oxygen, stop anesthetic (if gas), rub body, and/or give artificial respiration.
2. Heart rate is very slow and below the normal range.
3. Blood pressure is low.
4. Corneal reflexes may be absent or may persist into very deep planes of anesthesia. This is an unreliable indicator.
5. Mucous membrane color is no longer pink. Color will be gray or blue if too deep.

IV. SUMMARY

It is important to assess ALL the criteria when performing anesthesia. No one particular parameter can tell the whole story. It is also important to reassess the animal's depth every 10 minutes throughout surgery. Anesthetic depth changes over time due to surgical stimulations, and metabolism of the drug administered. Anesthesia is a constantly changing plane of unconsciousness that can easily become too deep or too light.