INHALATION ANESTHESIA MACHINE / VAPORIZER / WASTE GAS MAINTENANCE

Overview/Purpose

To reduce risk of anesthetic gas exposure to animals and personnel, proper maintenance of anesthesia equipment, appropriate waste scavenging systems, and safe administration techniques must be employed. Preventative maintenance is key in reaching this goal. ULAR machines are maintained by ULAR while maintenance of lab owned machines is required by the research team.

Personnel must be properly trained to provide safe anesthesia to animals and in the proper use and maintenance of anesthetic machines. Training is available through ULAR http://ular.osu.edu/training/animal-handling-and-technique-training/.

Definition

1. **Anesthesia Machine.** - The entire piece of equipment that is used to deliver precise amounts of inhaled anesthetic gas and/or a carrier gas (usually air, O2 or CO2, alone or in a mix). It consists of multiple parts (precision vaporizer, carrier gas regulators, flow meters, delivery/breathing circuits and scavenge systems and possibly a rebreathing reservoir (bag).
    a. Rebreathing systems – for animals weighing over ~5kg
    b. Non-rebreathing systems – for rodents and animals weighing under ~5kg.
2. **Breathing Circuit**: The tubing that delivers the fresh gas/anesthetic gas mixture from the machine to the patient.
    a. Rebreathing circuits direct the expired gases through a soda lime canister for absorption of carbon dioxide, which are then “rebreathed” by the patient.
    b. Non-rebreathing circuits are designed to deliver oxygen and anesthetic gases with less resistance to breathing in small patients and have a higher fresh gas flow to remove carbon dioxide.
3. **Induction Chamber**: A transparent box or container that animals can be placed within to induce anesthesia by enveloping the animal with the anesthetic gas. Such chambers should be placed inside of a biosafety cabinet (BSC) or fume hood if not connected to an active scavenge system to draw off excess gas.
4. **Precision Vaporizer** – A component of the anesthesia machine used to hold and deliver the volatile anesthetic gas.
5. **Scavenge Systems**: These systems remove halogenated waste gas from the anesthetic system so they do not return to the patient or the operating personnel.
    a. Active system: incorporates a vacuum to pull off waste gas.
    b. Passive system: utilizes the assumption that anesthetic gases are heavier than air. Passive flow is used to carry the waste gas through a charcoal canister which can absorb the waste gas. E.g. F/AIR, VaporGuard
6. **Vaporizer Calibration:** A process of taking apart the precision vaporizer, cleaning the components and replacing worn gaskets and verifying gas outputs with a refractometer. Such an evaluation must be performed by a qualified vendor off-site (i.e. Patterson and Henry Schein).
7. **Vaporizer Verification:** This is a process of verifying the percentage of volatile gas that the vaporizer puts out at each setting. At any time, if the vaporizer falls outside of a 20% range it must be taken out of service and sent out for calibration.

Requirements

1. **Performance evaluation:** **Before each use** the entire machine must be visually checked for proper function and integrity. It is recommended a checklist (see example) be available at the machine level but not required.
   a. All tubing must be connected and free from leaks and kinks including breathing tubing/circuits and scavenge tubing.
   b. Breathing bags (if used) must be intact and free from cracks.
   c. The carrier gas tanks must fit snugly onto the regulator yoke with no leaks and have sufficient levels for the duration of the procedure.
   d. A scavenge system must be in place and functioning properly. A passive system requires a record of the time or weight of the canister before each use to identify when it needs to be replaced. All exhaust holes on the canister must be unobstructed. When using an active system, ensure that the vacuum is turned on and working at an appropriate flow.
2. **Personnel must take all measures to avoid breathing in anesthetic gases.**
   a. Induction chambers should be connected to an active scavenge system or used inside of a BSC/Fume hood.
   b. Nosecones must fit snugly to avoid the potential for leakage of gas around the nose and work should be done inside a BSC/Fume hood.
   c. If using an endotracheal tube, ideally they should be cuffed, but if no cuff is available then ensure the proper size is being used to acquire a snug fit.

3. **Expectations for Verification and Calibration**

Type of System	Rebreathing	Non Rebreathing
Verification Process	No longer required annual	Once every 3 Years
Calibration	Once every 3 Years or Performance Based (>20%)	Performance Based (>20%)

Additional Information/Guidance

1. Anesthesia Machine Checklist (ORRP Investigator Guidance webpage)

References

1. Understanding Rebreathing vs. Non-Rebreathing Anesthesia, DRE News, http://www.dreveterinary.com/veterinary-news/understanding-rebreathing-vs-non-rebreathing-anesthesia/
2. Handbook of Veterinary Anesthesia, 5e 5th Edition, Muir et al. 2012

History of Revisions

049-00 - new policy approved 08/16/2013
049-01 - The vaporizer validation percentage was changed from 10% to 20% of the metered concentration to reflect industry standard. 05/16/14
049-02 –The vaporizer must be validated annually or calibrated at least once every 3 years unless the manufacturer indicates otherwise. 03/27/15
049-03 – This policy was reformatted. Revisions reflect definitions, a performance evaluation, and the expectations for verification and calibration of anesthesia machines. Approved 01/20/17