VETAMAC

VAPORS

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To Rebreathe or Not Rebreathe

This issue of Vapors will discuss the non-rebreathing (NRB) system, its use, and different configurations. When a non-rebreathing system is used, it is important to know how this system differs from a rebreathing system. The name, non-rebreathing, describes the function: none of the expired gas is rebreathed. This issue of Vapors will discuss the two most commonly used styles in veterinary medicine.


Figure 1

The Bain circuit is a common system used almost exclusively in the research arena but not as widely used in practice. The Bain circuit is sometimes confused with the Universal-F rebreathing circuit because they both have coaxial design. They are not the same and are not interchangeable. In the Bain circuit (see figure 1), the fresh gas from the flowmeter and vaporizer flows through the small tube which enters the large outer tube near the end distal to the patient. The fresh gas continues through the small inner tube through the circuit and terminates at the patient end. The ET tube or mask fits on the patient end. The distal end of the outer tube will accept a connection to WAG evacuation or will attach to a Bain system adapter with a pop-off valve and a bag. One disadvantage to this system is that the entrance of the fresh gas tube through the wall of the outer tube is prone to leak and usually requires a new circuit. The inner tube can also detach from its connection creating a large amount of dead space. The Bain adapter for the anesthetic machine is also expensive but is a one-time purchase.

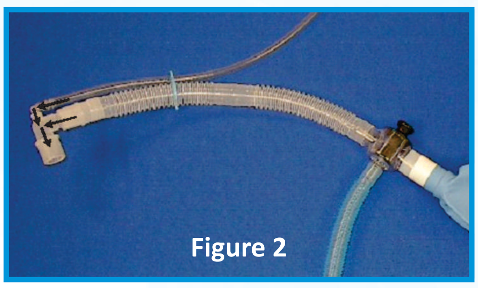


Figure 2

The Jackson-Rees is the other common NRB circuit. This style is a variation on the Ayres Tee piece. The SafeSigh is one example of a Modified Jackson-Rees (see figure 2). It has a fresh gas tube that delivers fresh gas to an adapter that attaches to the ET tube or mask. That adapter also has a piece of 22mm tubing attached that can be 6” to 2' long. The distal end of that tube attaches to a valve that can be closed or occluded to “bag” the patient. The valve is commonly a “T” which allows the connection of a bag and a connection to WAG evacuation. There are pressure manometers that can be attached to most of these styles of NRB systems (see figure 3).

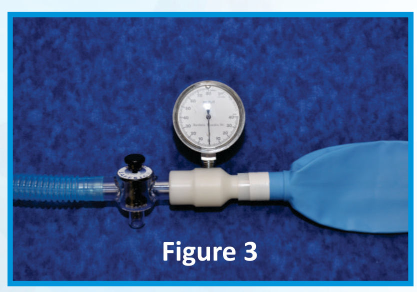


Figure 3

Most questions surrounding the use of NRB systems concern the correct flow rate of oxygen. In the previous issue of Vapors, rebreathing tubes were marked to illustrate the distance inspired and expired gas moved during one breath. In the NRB system, the inspired gas comes from both the 22mm tube and the fresh gas flow (see arrows in figure 2). Since no expired gas is to be rebreathed, the expired gas must be transported distally in the 22mm tubing so that the next inspiration receives no expired gas. So from the end of one expiration to the beginning of the next inspiration, the gas must move in the tube an amount equal to 1 tidal volume. How far must the expired gas move? It depends on the weight of the animal.

For this illustration, assume that the tidal volume is 15ml/kg and the animal weighs 2kg and is breathing 20 times per minute. This patient has a tidal volume of 30mls (15ml/kg x 2kg). This means that between each breath (20 times a minute), 30mls of fresh gas must flow into the 22mm tube. Therefore 30mls x 20 times a minute is 600mls/min that must flow into the system. This is the absolute minimum flow rate for this patient. Observe in figure 4 that there is 4mls of volume per centimeter (1 mark) of length. This shows that the gas will flow approximately 7.5cm per breath. If inspired CO_2 cannot be measured, the flow rate should be higher than this minimum of 600mls/min to allow for individual variation, non-uniform flow of gas, inaccuracy of flow and changes in breaths per minute.

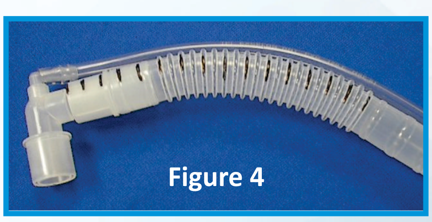
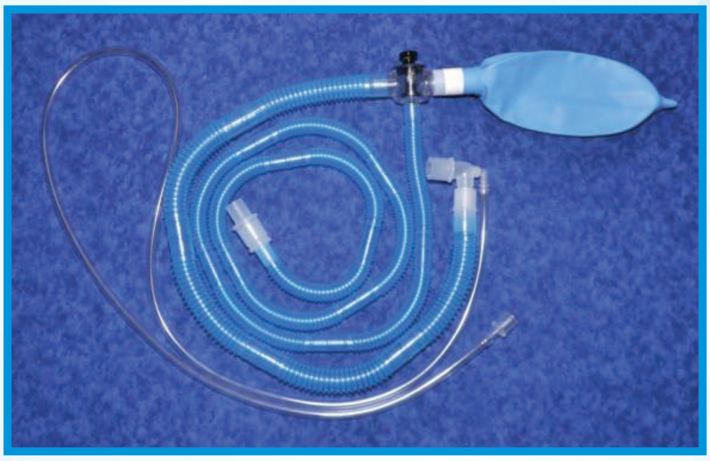


Figure 4

What are the advantages and disadvantages of the NRB system? One primary advantage is that there is negligible resistance to breathing. In a rebreathing system, the one way valves require a small amount of energy to open. In very small patients, this requirement, though minimal, may still have a consequence to the small patient. Another advantage is that changes in the concentration of inspired anesthetic takes place almost immediately because there is no mixing of fresh gas and expired gas. The time constant (see Volume IX, Issue 1 of Vetamac Vapors available on our website) is a matter of seconds not minutes. The most often cited disadvantage of this system is that the patient is cooled by the constant flow of fresh oxygen and the respiratory tract membranes become dry.

The NRB system is a safe alternative to the rebreathing system in small patients and provides better and quicker control of the inspired concentration of anesthetic. The next issue of Vapors will discuss the use of induction chambers to administer anesthesia.

Product of the Quarter



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