VETAMAC VAPORS

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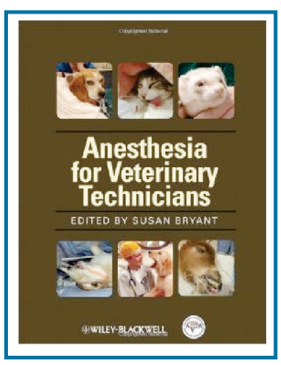
## How Many O's Are Enough?

One of the primary functions of an anesthetic machine is to deliver oxygen. This issue of Vapors will discuss why oxygen flow is needed and how much flow is required.

Oxygen is provided, first of all, to sustain the life of the patient during the course of a procedure. The anesthetic machine has a flowmeter that delivers a flow in mls/minute or liters/minute. Two types of systems are commonly used to deliver gas to the patient: 1) a rebreathing system and 2) a non-rebreathing system. In a rebreathing system, a portion of the oxygen delivered is rebreathed by the patient. This rebreathing of a portion of the expired gas is possible because the system has uni-directional or one-way valves and provides for the removal of expired $CO_2$. This prevents the rebreathing of $O_2$ (and anesthetic) before the $CO_2$ is removed. It is possible (but not likely) that one specific atom of oxygen introduced during induction could remain in the system for the duration of the procedure. However, when a non-rebreathing system is used properly, there is no rebreathing of any of the expired gas, therefore the oxygen flow must be sufficient to move the expired gas away from the patient so no rebreathing occurs. It is obvious that the non-rebreathing system requires a higher flow than the rebreathing system.

The question of oxygen purity should be briefly discussed since oxygen concentrators and generators are being more widely used. Is 100% oxygen necessary for patient survival? The answer is no. Even though it is not recommended clinically, there are research applications that use room air for anesthetic procedures. Most oxygen concentrators produce 90-95% oxygen. If the concentration drops to 80-85%, this is probably of little or no consequence to the patient but rather indicates a failure of the concentrator.

When performing inhalation anesthesia, oxygen is required for a second reason: it is the carrier gas for the anesthetic vapor. (The only exception to this is when the vaporizer is in the circle and this will not be discussed.) There must be gas flow through the vaporizer to pick up and carry the vaporized anesthetic to the breathing system. This flow does not affect the concentration of anesthetic but does affect the quantity of liquid agent consumed. At 1 liter/minute flow and a 2% setting on the vaporizer, 6 mls of liquid will be consumed per hour. If the flow is 2 liters/minute, the consumption will be 12 mls/hour. (Visit our website, www.vetamac.com and follow the link for "Knowledge" to find a consumption chart for both isoflurane and sevoflurane).




The question now is how much flow is required? The first issue to address is the metabolic requirement of the patient which is approximately 1 ml/lb/min. With a 50 lb. dog, the amount of oxygen removed from the system would be 50 mls/min. It is evident that the flows commonly introduced into the circuit are in excess of what the patient requires. This raises the question of why excessive flow is used. One reason is that there may be leaks in the anesthetic system or the evacuation system may not be functioning properly allowing gas to escape from the system necessitating increased flow. Another reason is that it is easy to pre-determine a set flow and use that as a standard flow for all procedures. This minimizes the chance for errors that might occur when calculating a flow. Finally, concentration calibrated (direct read) vaporizers require a minimum flow for the output to remain constant. If the flow is below 500 cc/min, the output will tend to be lower than the dial setting. There must be enough flow to overcome the resistance created in the vaporizer so that a portion of the flow is diverted into the vaporization chamber.

What oxygen flow should be used? If the vaporizer requires 500 mls/min flow, and if the patient consumes 5 ml/lb/min, that is a sufficient flow for a 100 lb. patient. Therefore, any flow above 500 mls/min would be sufficient for any animal 100 lbs. or less. It seems that most practices use a 1 liter/minute flow for all patients. There are some that use a higher flow and some a lower flow according to their preference.

As stated above, a non-rebreathing system requires a higher flow rate because the flow of fresh gas is what moves the expired gas away from the patient. It is recommended that a minimum flow of 1.5 liters/min be used with a non-rebreathing system. The flow should be 2.0-2.5 liters/min for patients above 15 lbs.

If your practice requires a calculated flow rate, see the chart in Anesthesia for Veterinary Technicians edited by Susan Bryant, page 84.

**One final reminder, flow rate determines the amount of liquid anesthetic agent consumed.**

By Harry Latshaw
MS, RVT, VTS (Anesthesia)

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