ISOFLURANE OR SEVOFLURANE - DOES IT REALLY MATTER?

With the removal of halothane from the US veterinary market, veterinarians who hadn't already transitioned to use of isoflurane or sevoflurane are faced with selecting between them. The question of whether a practice should switch from isoflurane to sevoflurane or have both is also frequently raised. We currently use both depending on the patients age, general health, length of the surgical procedure, and surgeon's preference. The following discussion may help you understand the differences between the two gas anesthetics we have available and commonly use.

Blood Gas Solubility
Speed of anesthetic onset and recovery and the ability to change anesthetic depth precisely and rapidly are directly related to the agent's blood gas solubility. When all other factors are equal, changes occur faster when blood gas solubility decreases and so is most rapid for sevoflurane and slowest for halothane. Changes occur more rapidly with sevoflurane than with isoflurane. Clinically this impact is most notable in patients being anesthetized with an inhalant agent in the absence of other drugs (less common approach in today's practice except perhaps with small mammals and birds). While efficiency may be improved with a more rapid onset, offset and change in anesthetic depth, patient monitoring is critical to avoid an anesthetic overdose.

Vapor Pressure
The vapor pressure at a given temperature determines the maximum concentration of the inhalant. So for example, at sea level concentrations approximating 32% are possible for halothane and isoflurane, 21% for sevoflurane. Because these concentrations are well above the necessary anesthetic dose in human beings and animals, these drugs are administered using vaporizers calibrated to specifically administer clinically relevant concentrations. Agents with similar vapor pressures (e.g., halothane and isoflurane OR sevoflurane) have used interchangeably in the same vaporizer after thorough cleaning and recalibration. This has been historically used as a cost saving mechanism, but in today's environment manufacturers will frequently provide a vaporizer if the practice purchases sufficient inhalant agent.

While Mean Alveolar Concentration (MAC ie. the percentage of gas administered) vary slightly between species, for a specific agent they tend to be within a fairly tight numerical range. MAC is a good standard of comparison when evaluating physiologic effects (e.g., blood pressure, PaCO2) of a fixed concentration of the inhaled agents between species or effects at different concentrations within a species. While MAC may be used to guide anesthetic delivery in clinical patients, it is important to keep in mind that MAC is determined in healthy patients in the absence of modifying drugs. However, it does provide an indicator of drug potency; higher MAC values reflect a less potent drug or the need to get to a higher concentration to have a similar effect. Halothane is more potent than isoflurane which in turn is more potent than sevoflurane. This partially offsets the clinical effects of the differences in blood gas solubility observed for these agents. For example, the blood gas solubility for sevoflurane is approximately half that of isoflurane, but the MAC is approximately double. So while it takes less time for anesthetic uptake with sevoflurane, the concentration necessary to anesthetize a patient to a given depth is higher.
Cardiovascular and Respiratory Effects
Cardiovascular and respiratory depression occurs in a dose related manner with all the aforementioned inhaled agents. The magnitude of these changes at a given dose is both agent and species specific. Of the agents, halothane causes more cardiovascular depression, but less respiratory depression than isoflurane and sevoflurane which have roughly equivalent effects in the clinical dose range.

Other Considerations
Two other factors that should be considered when selecting between isoflurane and sevoflurane today are the reactivity of the compounds and their cost. Sevoflurane does react with carbon dioxide absorbents to form Compound A which has the potential, albeit limited or in extreme clinical circumstances, to be nephrotoxic. To minimize the level of Compound A present in the circuit, low flow or closed circuit anesthesia with sevoflurane is not recommended. This has an additional impact on the cost of using this agent which is while recently reduced in prices is still considerably more expensive than isoflurane. Example: Isoflurane @1liter of O2 per minute 1.4 %, costs 63 cent per hour; Sevoflurane @1 liter of O2 per minute 2.3%, cost $3.68per hour.

For many years, isoflurane has been the predominant inhalation agent in small animal practice in the US (vs. halothane). It offers greater cardiovascular stability, an ability to change depth more rapidly and is metabolized to a lesser degree than halothane. Veterinary patients unlike human patients do not seem to react adversely to isoflurane when administered by a mask. With the availability of the newer agent sevoflurane which like isoflurane is licensed for use in dogs, veterinarians have been faced with an additional choice of inhaled agent. The advocacy to switch to this agent has been largely driven by marketing of its rapid onset and offset. The literature is mixed in this regard and clinical impression suggests that in the presence of modifiers (premedications, injectable induction agents, analgesics, etc.) commonly used in peri-anesthetic patient management today, these potential advantages are less. The ability to quickly change anesthetic depth with sevoflurane can be an advantage as long as someone knowledgeable in its use is present during the anesthetic to monitor the patient. Cardiovascular and respiratory effects are very similar for the two agents. While likely not to be clinically important in the majority of patients the question of sevoflurane use in patients with renal compromise remains. The cost difference is not as substantial now as when sevoflurane was first introduced, but should be considered when choosing between the two agents.