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## WAKING UP DURING SURGERY?

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By Jenny Flynn, LVT

There's nothing more concerning than a patient being 'too light' under anesthesia or feeling the pain of a procedure. Most of the time, however, the situation can be traced back to not implementing equipment-maintenance routines or not using a preflight checklist.



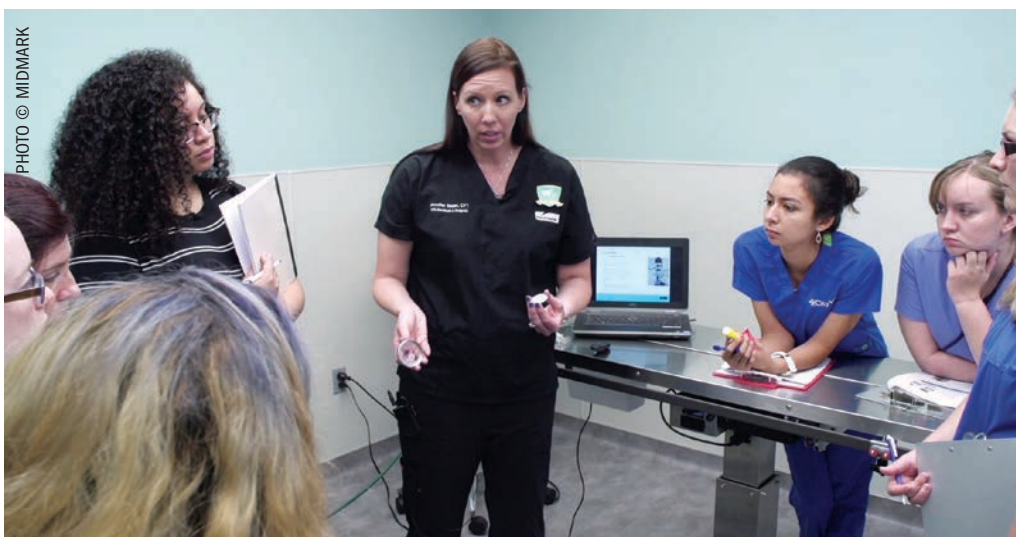
The story starts like this: Baxter, the pug, is on the table, right on schedule for his first dental procedure. It took a little convincing, but Mrs. Robinson finally agreed with your recommendation that Baxter was long overdue for a comprehensive oral radiographic exam (CORE). By then, the tartar was evident and she no longer enjoyed his increasingly stinky kisses. Mrs. Robinson had been a little apprehensive about putting him under anesthesia, but you assured her Baxter would be comfortable and under your watchful eye and experienced hands. You were thrilled to begin using your new digital dental radiograph system. Yet, just after induction and as the technician was working through a set of full-mouth X-rays, Baxter began to stir and suddenly bit down on the new digital sensor. You were sure Baxter was asleep, but you now hold the tattered and crushed remains of the sensor for which you paid thousands. You wonder what went wrong.

I lead a team of clinical specialists who field thousands of calls every year regarding veterinary anesthesia machines and monitoring equipment. A good number of them are from clinicians concerned about patients being too light or even waking under anesthesia. And while most calls begin with a concern there is an equipment problem, we find there are many factors that can contribute to the difficulty of keeping patients at the ideal plane of anesthesia. The reasons generally fall into one of three areas or a combination thereof: equipment, protocol, and processes. The larger theme that overarches these is a need for a comprehensive staff training program.

#### Equipment

The best way to avoid situations such as Baxter's is to prevent them from happening in the first place. A lack of proper maintenance is the likely cause in many of the cases we troubleshoot, characterized by leaks in anesthesia machines or a failure to properly maintain the vaporizer. Equipment issues aside, it is critical those responsible for delivering anesthesia understand how an anesthesia machine operates.

It is a recommended best practice that a staff member perform a leak test prior to each anesthetic procedure. Leak-testing takes a minimal



Jennifer Sager, BS, CVT, VTS (anesthesia-analgesia), training technician staff on maintaining an anesthesia machine.

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amount of time—a couple minutes at most—and will prevent fumbling with the machine while trying to induce or maintain the patient under anesthesia. Though you wouldn't think much could happen between uses, it is common to find holes in the consumable accessories, including the breathing bag and circuit. Depending on how often an anesthetic machine is used, most suppliers recommend it is serviced every six to 12 months to prevent problems arising.

Vaporizers require a different type of service and maintenance on a regular basis, typically every year, or as recommended by the manufacturer. This is not to be confused with having an authorized anesthesia machine service provider perform a field service or preventative maintenance call on your anesthesia machine. This entails leak-testing the equipment, assessing and replacing consumable parts that show wear and tear, and perhaps doing a field test using a properly calibrated gas refractometer to determine whether the vaporizer output is within an acceptable range. Vaporizers should only be serviced by the manufacturer or at a qualified facility where the unit can be tested and calibrated under strict environmental controls. A typical service call consists of completely disassembling the vaporizer, cleaning all internal components, replacing its wicks and gaskets, adjusting the thermo control, and performing a final calibration. Once reassembled, the unit is tested under strict protocols that account for anesthetic agent stabilization time, temperature, humidity, and atmospheric pressure, all of which are critically important to vaporizer accuracy. The serviced vaporizer should come with a calibration certificate.

Anesthetic machines and vaporizers have a finite life. If vaporizers are not serviced on

a regular basis, they go out of calibration beyond their normal deviation of +/- 10 percent. Not infrequently, output may be higher at lower settings and staff responds by nudging the dial lower to compensate (*i.e.* standard vaporizer anesthetic maintenance settings are less than two percent for isoflurane or less than three percent for sevoflurane). When the vaporizer is recalibrated or replaced, the anesthetist may continue using the same settings for the new vaporizer out of habit, and patients may start showing signs of getting light. Unfortunately, blame for the problem is misplaced on the new vaporizer instead of recognizing the correct setting is not being used for induction and maintenance. Recommended guidelines indicate surgical anesthesia should be 1.2 to 1.5 minimum alveolar concentration (MAC).<sup>1</sup>

Understanding the function of anesthetic machine components and being able to trace the flow of oxygen and fresh gas through it allows staff to quickly and easily identify and correct the cause of most anesthetic problems, including leaks and improper hose connections. It is crucial for the anesthetist to be aware of hose connections, as failure to connect the hosing properly prevents patients from receiving fresh gas and they will eventually wake. Thus, understanding that oxygen exiting the flowmeter should enter straight into the vaporizer's inlet minimizes the chances of connecting the hoses incorrectly. Additionally, being able to trace the flow of gasses and understand the requirements of each style of breathing circuit—rebreathing and non-rebreathing—allows for an accurate connection when using a non-rebreathing system.

### Protocol

Once the equipment checks out, the next step is to look at protocol. The most frequent

issues contributing to an elevated risk a patient might awaken during a procedure include not giving the animal pain medication or premeds, inaccurate vaporizer settings, or not adequately monitoring patient vital signs and reflexes.

There are many reasons to provide preanesthetic medications (tranquilizers and/or sedatives), including easing induction and recovery, or to reduce the amount of general anesthetic required. Yet, we often receive calls where no premeds were administered, and the patient is fighting going under anesthesia. In these circumstances, the worst-case scenario is some patients awaken because they are feeling the pain of the procedure. Needless to say, the medical team needs to discuss, agree on, and establish proper evidence-based preanesthetic and pain-management protocols, and establish training and checklist procedures that ensure they are followed for all anesthetic cases.

Next, we might ask about the vaporizer setting. It is often the case the vaporizer's percent concentration is not appropriate for the specific phase of the anesthetic procedure being done. For example, we've seen instances where staff is keeping the vaporizer setting at a percentage much lower than suggested rates when inducing and/or maintaining a patient. When increasing the vaporizer setting, keep in mind the notion of time constants to help remember and account for how long it takes for the change in concentration to make its way through the system and ultimately reach the patient. In addition to boosting the vaporizer percentage, when a rapid increase in anesthetic concentration is called for, the oxygen flowrate also should be raised.

Hands-on monitoring of our patients' vital signs, especially

reflexes, are often missed after induction and while maintaining a patient on an adequate plane of anesthesia. Checking muscle tone, pedal reflex, and eye positioning are just a few overlooked techniques for evaluating a patient's anesthetic status. The responses we get from pinching the pad, assessing the jaw tone, or by testing the blink reflex are quick assessments and effective gauges for determining anesthetic depth. Most of these techniques require nothing other than an experienced technician with an understanding of what the response indicates.

And finally, electronically monitoring our patient's vital signs by connecting a multiparameter monitor as soon as possible is critical to patient safety and is widely regarded as a standard of care. In particular, following the American College of Veterinary Anesthesia and Analgesia (ACVAA) guidelines and monitoring end tidal CO<sub>2</sub> can provide instant information about intubation and how well the patient is ventilating. Further, it will immediately call attention to a malfunctioning anesthesia machine.

### Process

One area of concern that is often underappreciated is failing to give the patient enough time to get back to an anesthetic plane after moving him from prep to surgery. Another is waiting too long to start the procedure after premeds are given. Both situations can occur in a busy practice when an emergency case shows up right after you've induced your patient, or when hospital layouts stretch distances between prep, treatment, and surgery suites. Double-checking reflexes, confirming plane of anesthesia before proceeding, and ensuring you didn't exceed the life of the premed with some unplanned delay are good habits to adopt to help avoid pitfalls that could

lead to a patient struggling to go under anesthesia or becoming light due to surgical stimulation.

### Training

Finally, the best advice we give is to pursue a culture of learning and to invest in training. Evidence-based medical knowledge is constantly changing and evolving. The labor market is tight, and it is more and more difficult to hire and retain well qualified and highly trained technician staff. No longer can we depend on tribal knowledge or on-the-job training when it comes to patient safety issues like anesthesia. Hospitals that make ongoing investments in staff training, encourage self-study, and reward excellence are better equipped to provide effective and reliable veterinary care. They host team-training events so employees learn side-by-side and can hold each other accountable to elevated practices and protocols. They seek anesthesiologists or veterinary technicians with specialties in anesthesia/analgesia to come to their hospital to train staff in their own environment and on their own equipment.

Establishing the right habits, practices, and protocols will help ensure the best anesthetic experience for doctor, patient, technician, and client. ●

*Jenny Flynn, LVT, is the supervisor of animal health clinical specialists for Midmark Corp. Special thanks to Andrew Schultz, Jr., MBA, former director of monitoring and critical care for Midmark and the company's current director of business development and clinical services, for his contribution to this article.*

### REFERENCES

- <sup>1</sup> Contribution by Donald Sawyer, DVM, PhD, DACVAA

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