Holter monitors (named after Norman J. Holter) are ambulatory ECG recorders. They record cardiac electrical activity continuously as long as the recording memory permits—usually 24 to 48 hours. Older analog Holter monitors record electrical activity to a cassette tape, whereas newer digital units record to memory cards.

Event monitors are similar to Holter monitors in that they are also ambulatory ECG recording devices. However, they continuously record for a brief period (10 to 15 minutes) into a memory loop and overwrite data until the patient presses a button. The ECG data are then saved from the previous 5 to 10 minutes and for the following 5 to 10 minutes (i.e., before, during, and after the "event"). Every time the event monitor is triggered, it adds a new 10- to 15-minute file to memory.

INDICATIONS
Holter monitors are used to identify cardiac arrhythmias, quantify and characterize cardiac arrhythmias, and monitor response to antiarrhythmic therapy.

Identifying Arrhythmias
In many cases, owners describe collapse episodes in dogs or cats (syncope or episodic weakness). If arrhythmia is causing these episodes, it is often not detected on routine in-house electrocardiography. Remember, a 2-minute ECG records approximately 0.1% of total daily cardiac depolarizations (200 beats in 2 minutes, out of a total of 150,000 beats/day), so the odds of observing an intermittent event are very small. If collapse occurs relatively frequently (daily or several times a week) or can be induced by particular events or behavior, a 24-hr ECG recording with a ventricular premature complex, so a diagnosis is not possible. However, a Holter examination will reveal the extent of the arrhythmias.

In sick sinus syndrome of miniature schnauzers, more than one arrhythmia (bradycardia and tachycardia) may account for clinical signs. A Holter recording will help identify which arrhythmias are present and which are causing the clinical problems.

Monitoring Response to Antiarrhythmic Therapy
Studies have shown marked day-to-day arrhythmia variability (up to 80%). Thus, to document a response to antiarrhythmic therapy, reduction in arrhythmia exceeding 80% is necessary. Holter recordings before an antiarrhythmic drug is started and after steady-state therapeutic levels are reached allow clinicians to determine the efficacy of treatment and to adjust or alter medications.

Quantifying & Characterizing Arrhythmias
Boxers are diagnosed with arrhythmogenic right ventricular cardiomyopathy if they have more than 50 ventricular premature complexes in 24 hours. During a routine in-house ECG, many boxers have normal rhythms, or a single
ADVANTAGES

Holter monitors are much more sensitive than routine ECGs in diagnosing intermittent arrhythmias and in establishing a cause for episodic weakness or syncope. They are the best way to monitor antiarrhythmic therapy and are relatively sensitive and specific in identifying occult cardiomyopathies in certain breeds.

Event monitors are useful in identifying cardiac causes of infrequent episodic weakness or collapse.

DISADVANTAGES

Although the size of the monitors has decreased substantially, they are still relatively cumbersome for animals to wear. For toy breeds, puppies, and cats, the recording must usually be done in the hospital, with the recorder in the cage beside the animal.

Attaching the monitor is demanding. Inappropriate attachment of the electrodes results in unreadable tracings or tracings of poor quality. Since the hospital is charged for analysis regardless of the quality of the tracing, this can be an expensive exercise.

Analysis and interpretation are generally done by either Holter services (usually human medical services) or veterinary cardiologists. Knowing normal variations in dogs or cats is important to avoid misdiagnosing a normal finding as an arrhythmia. For this reason, clinicians should always request full disclosure of the recording from a Holter service and either have a veterinary specialist interpret the findings or learn how to do it themselves. Where possible, multiple leads should be recorded simultaneously. Trend graphs should be examined to identify potential patterns in arrhythmia occurrence that might determine therapeutic strategies.

Electrode displacement with event monitors is even more likely, because they are attached for longer periods. Additionally, owners need to trigger the units to capture the rhythm during an episode—if an episode is not observed or if the owner neglects to press the button, it will not be recorded.

Recently, Medtronic released an implantable event monitor (Reveal) that can function for up to 18 months. It is very small (so it works even in toy breeds or cats), but requires a subcutaneous surgical implantation and manual triggering to record an event. Use in veterinary patients has been limited.

Sensitivity of Holter monitors in identifying a cause of episodic weakness or syncope is only about 50% with a single recording; in other words, many arrhythmic causes of collapse go undiagnosed. Sensitivity—and cost—increase as consecutive daily recordings are made.

ECONOMIC IMPACT

Holter monitoring and event recording are expensive. Most companies or specialists that provide Holter monitors and analyze the tracings charge $110 to $200 for analysis and interpretation. Thus, after the hospital’s mark-up, serial monitoring can be expensive to the client.

See Aids & Resources, back page, for references, contacts, and appendices.