Continuous Glucose Monitors for Diabetic Patients

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Abstract

This article is aimed at answering questions veterinary team members may have when using a continuous glucose monitor (CGM), as recommended in the 2022 update of the AAHA Diabetes Management Guidelines for Dogs and Cats. This article discusses what a CGM is, why there may be potential differences between the glucose reading of a CGM and a traditional glucometer, which patients may benefit from using a CGM, ease of placing and maintaining a CGM, costs associated with a CGM, and important information for clients.
In the 2022 update to the AAHA Diabetes Management Guidelines for Dogs and Cats, continuous glucose monitors (CGMs) were added to the recommendations for managing diabetic patients. CGMs have been growing in popularity since the FreeStyle Libre 14-Day System (Abbott, freestyle.abbott) became available in the European market in 2014 and in the United States in 2016. An article published in the Journal of Veterinary Internal Medicine in 2016 showed promising early results for use in veterinary medicine. Compared to its predecessors, the newest generation of CGMs require no manual calibration and last significantly longer, allowing for higher-quality care for veterinary patients. However, understanding the indications and limitations of CGMs is key for optimal patient care.

**Take-Home Points**

- Continuous glucose monitors (CGMs) read interstitial glucose levels and are most accurate when used on patients that have a normal hydration status.
- CGMs provide 24-hour glucose curves and can catch hypoglycemic events or Somogyi reactions, helping veterinary teams create more effective patient management plans.
- CGMs are simple to place and maintain on most patients, with a few additional steps for veterinary patients compared to use on humans.
- Pricing for CGMs varies depending on the pharmacy used. Clinics are encouraged to charge for lab work interpretation and placement.
- Clients should be proactively educated on expectations for communication from veterinary personnel and what to do if patients’ glucose numbers are out of range.

**FIGURE 1.** (A) The continuous glucose monitor contains a subcutaneous probe that is placed through the skin into the interstitial space. (B) The application device is applied firmly to the patient with moderate pressure to ensure good sensor contact. (C) The application device is then gently removed.
WHAT IS A CGM?

A CGM is a wearable device applied to the skin that uses a subcutaneous probe placed into the interstitial space to read glucose concentrations (FIGURE 1). These probes, or wires, measure an enzymatic reaction called glucose oxidase to determine interstitial glucose levels, and the wire generates an electrical signal proportional to the interstitial glucose concentration (FIGURE 2A). This signal is then interpreted within the sensor to produce an interstitial glucose number. At this time, the brand recommended for veterinary use is the FreeStyle Libre 14-Day System. This CGM is only approved by the U.S. Food and Drug Administration for use in humans. A new veterinary system called the GluCurve Pet CGM (ALR Technologies, glucurve.com) has been recently introduced; however, not much information on this product was available at the time of publication.

The sensor of a CGM stays attached to the patient and gathers information for a specific amount of time (FIGURE 2B). The FreeStyle Libre system works for a maximum of 14 days, in effect giving a 14-day glucose curve. The interstitial glucose numbers obtained by the CGM sensor are stored until either the corresponding handheld CGM reader or a compatible cell phone scans the sensor. In the case of the FreeStyle Libre, the sensor stores 8 hours of information and needs to connect wirelessly to either a handheld reader or a compatible cell phone:
- If the FreeStyle Libre reader is used, it will then need to be connected to a computer for the results to be uploaded into a LibreView patient account.
- If a cell phone is used, the results are automatically uploaded to a linked LibreView account.

If the client chooses to use a cell phone to read the sensor, then the cell phone connected is the only reader that can be used with that sensor. In cases of a hospitalized pet, using a reader and not a client’s personal cell phone is recommended; otherwise, the cell phone would need to stay with the patient.

The LibreView patient account stores data from each individual patient. The client can link the patient account to a clinic account, allowing the attending veterinarian immediate access to the results so they can interpret the glucose curve results.

WHY DO CGM READINGS SOMETIMES DIFFER FROM GLUCOMETER READINGS?

A handheld glucometer reads blood glucose levels, whereas a CGM reads interstitial glucose levels. In a patient with normal hydration status, the blood glucose and the interstitial glucose levels will equilibrate within a few minutes of blood glucose changes. However, if a diabetic patient is dehydrated (e.g., in a patient with vomiting and/or diarrhea from pancreatitis, a patient in diabetic ketoacidosis), then changes in blood glucose will take significantly longer to translate to interstitial glucose levels because normal osmotic changes are not occurring. Therefore, if a patient is hospitalized due to dehydration, they need to be fluid resuscitated before CGM numbers can be relied on to adjust insulin dosing. Once the patient’s hydration status has normalized, the blood glucose and interstitial glucose numbers can deviate anywhere from 2.3 to 46.8 mg/dL from the average of the 2 values. In patients with low, normal, and high blood glucose concentrations, a study found that CGMs were 93%, 99%, and 99% accurate, respectively.

WHEN WOULD A CGM BE INDICATED?

Use of a CGM can be indicated in newly diagnosed diabetic patients, difficult-to-control diabetic patients, or diabetic patients with high fear, anxiety, and/or stress (FAS) when coming into the veterinary clinic.

A newly diagnosed diabetic patient would benefit from a CGM in several ways. CGMs can help monitor for any potential hypoglycemic events from starting insulin. It can also indicate a dose change if the glucose stays “high” (i.e., >500 mg/dL on most readers) for several days despite starting insulin therapy. The gold standard of care for newly diagnosed diabetic patients is a blood glucose curve at 1 week after starting therapy. However, if a CGM is used, the first 2 weeks are a continuous glucose curve and insulin therapy can easily be adjusted as the body gets used to supplemental insulin over the next several months.

The CGM is used for monitoring patients to ensure the insulin dose is correct and the patient stays within an acceptable range. Unlike traditional glucose curves that only capture a blood glucose reading every 1 to 2 hours, the CGM records the data every 5 to 15 minutes, depending on the manufacturer. This allows for a larger data set to provide a more accurate
assessment of the curve; in addition, it minimizes the possibilities of a missed Somogyi effect.

Somogyi reactions may be missed during a traditional glucose curve, as catching the glucose at its lowest point may not occur if it takes place between blood draws. The Somogyi effect is a normal rebound physiologic response to low blood glucose levels in patients with diabetes mellitus. With a rapid decrease in blood glucose, the liver is stimulated to release certain hormones, especially glucagon. This raises the blood glucose levels within a 12-hour period. Somogyi reactions also cause insulin resistance, leading to an increased difficulty regulating glucose levels. There have been cases where “difficult-to-control” diabetic patients were patients experiencing Somogyi reactions; without the data points provided by a CGM, the illustration of the glucose curve in its entirety is limited and the true nadir may be missed, resulting in an increased insulin dose by the clinician.

Patients can have hyperglycemia induced by a high FAS score, and this is one of the single biggest issues affecting a serial glucose curve. Multiple venipuncture and hospital trips are the biggest causes of FAS in these patients can have hyperglycemia induced by a high FAS score, and this is one of the single biggest issues affecting a serial glucose curve. Multiple venipuncture and hospital trips are the biggest causes of FAS in these

Figure 2 (A and B): Kip Carter

FIGURE 2. Components of a continuous glucose monitor. (A) The semipermeable membrane covering the subcutaneous probe allows glucose to pass through and come in contact with the inner layer, which contains glucose oxidase. The reaction of glucose with glucose oxidase creates hydrogen peroxide, generating an electrical current in direct proportion to the glucose concentration. The electrode at the center of the probe sends the signal to the external sensor, which translates the signal into a sensor glucose reading. (B) The sensor records, stores, and transmits the data to the monitor.
patients. By using a CGM, these patients’ glucose levels are monitored, allowing the readings to be easily obtained by simply waving the reader or cell phone over the sensor without the patient enduring stress. Many times, patients sleep through this process.

**HOW EASY IS A CGM TO PLACE AND MAINTAIN?**

Typically, a CGM is easy and relatively painless to place. A small shave spot and alcohol prep are all that are required (FIGURE 3A). However, additional adhesive is recommended as these devices are intended for human skin and not animal skin (FIGURE 3B). One to 2 drops of tissue adhesive on the adhesive pad and prepping the skin with an adhesive barrier like Skin Tac (Torbot Group, torbot.com) can help the sensor stay in place for the full length of the reading.

These sensors require minimal maintenance, with the biggest concern being patients scratching at or rubbing the sensors to try to dislodge them. To mitigate this issue, placing a t-shirt on the patient may help prevent dislodging of the sensor; however, in the author’s experience, most patients do not need this and will leave the sensor alone.

**WHAT IS THE COST OF USING A CGM?**

Prices vary between pharmacies. Sensors start around $120 and are a 1-time-use-only device. The readers start around $80; they are reusable, as long as the sensors and readers are the same brand and same models. To avoid the reader cost, a cell phone may be used, but it is important to remind clients that the phone will need to stay with the pet to ensure a reading can be obtained whenever necessary.

Recommending that clients check with multiple pharmacies or use a site such as goodrx.com can help minimize the cost of the sensors and the reader as these typically are not covered by insurance. Having sensors in-clinic can be an option for hospitals using CGMs frequently for their patients.

To capture costs involved with the placement of the sensor, along with the time and knowledge required for interpretation and consultation of the associated data received, clinics can establish charges that itemize individual tasks performed or develop a package deal. In the case of the FreeStyle Libre, a consistent package price can be charged every 14 days when the client comes in for placement of a new CGM. If the clinic chooses to forgo a package price, clients should be given an estimate of the charges at each appointment.

**WHAT IS IMPORTANT FOR CLIENTS TO KNOW ABOUT A CGM?**

It is important to provide clients with guidance on acceptable glucose levels, what to do if the glucose levels are above or below a certain set point, and how frequently the veterinarian will interpret the results and communicate with the client.

Sharing client-focused articles such as “Flash Glucose Monitoring With FreeStyle Libre in Cats and Dogs” from Veterinary Partner can be good resources to help clients understand the basics of the CGM. Providing a client handout such as “Using the FreeStyle Libre

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**FIGURE 3. (A) A continuous glucose monitor sensor is simple to place, requiring just a small shave spot (approximately 2 to 3 in²) and alcohol prep. The spot should be difficult for the patient to reach and have sufficient interstitial space to place the sensor. (B) Additional adhesive is recommended to help the sensor stay in place for the full reading.**

Figure 3 (A and B): courtesy Andrew Linklater, DVM, DACVECC
Sensor and Reader” can also be invaluable for clients to reference back to and be reminded how to work with the veterinary team to provide the best care possible for their pet.

Educate clients that using a CGM is a pain-free way for them to monitor their pets’ glucose levels at home while allowing the collection of data points for the veterinarian to monitor and interpret. CGMs also help the veterinary team create a treatment plan for long-term success with their pets. No matter what techniques are used for managing diabetic patients, it is important to get the clients’ buy-in to provide a good quality of life for their pets.

References

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With 20 years of veterinary experience, Yvonne was the 2021 president of the Academy of Internal Medicine for Veterinary Technicians and founder and cohost of the Internal Medicine For Vet Techs membership and podcast (internalmedicineforvettechs.com). She works as a clinical trainer for Ethos and loves to teach about a variety of medicine topics. Yvonne is passionate about elevating the profession and veterinary technicians around the world.