EFFECT OF A 24-HOUR FAST ON GLUCOSE REGULATION IN HEALTHY HORSES: COMPARISON OF 2 METHODS

H. Dingfelder, P. Johnson, C. Wiedmeyer, and N. Messer
University of Missouri, College of Veterinary Medicine

ABSTRACT

The effect of fasting on plasma glucose concentrations in horses is unknown. The goal of this study was to determine glucose changes in fasted normal horses compared to a non-fasted state. Recently, a continuous glucose monitoring system (CGMS) designed for use in humans has been validated for use in horses. The CGMS measures glucose concentration in the subcutaneous interstitial space which correlates with plasma glucose and records the concentration every 5 minutes. Therefore the CGMS can provide very detailed information about glucose changes as events occur. To determine the effects of 24 hours of fasting on changes in interstitial glucose a CGMS was placed on healthy, mature geldings [horses]. Horses were fitted with a CGMS approximately 12 hours prior to study commencement for acclimation and for the next 24 hours allowed to consume a routine ration. The horses were then feed restricted for the following 24 hours. Following fasting, the information from the CGMS was downloaded and results compared. In the non-fasted state, slight, sustainable increases in interstitial glucose can be observed with the event of feeding. The pattern of interstitial glucose in the fasted state appeared to be more stable with few fluctuations. The mean interstitial glucose concentration on the fasted day was decreased (less than 10%) compared to the non-fasted day and statistically significant (p<0.001). These results suggest that fasting creates significant changes in glucose in a normal horse and lays the foundation for future studies of glucose homeostasis in horses.

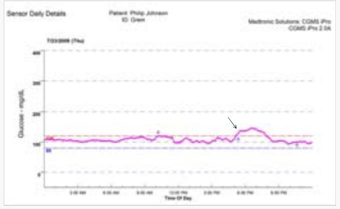

Figure 4: Interstitial glucose levels the day prior to fasting. Note the increase in glucose upon feeding.

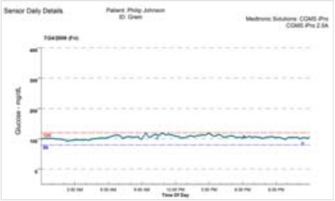

Figure 5: Interstitial glucose levels the day of fasting. Note little fluctuation of interstitial glucose pattern.

Figure 1: Horse with CGMS monitor in place.

Figure 2: CGMS Probe

$$\text{Glucose} + O_2 \xrightarrow[\text{Glucose oxidase}]{\nearrow \text{ Gluconic acid}} H_2O_2 \xrightarrow{0.6 \text{ volts}} 2H^+ + O_2 + 2e^-$$

Figure 3: Mechanism of CGMS sensor for determining interstitial glucose concentrations. Sensor contains glucose oxidase, which converts glucose into an electronic signal.

METHODS

Healthy horses owned by the University of Missouri served as experimental subjects. After physical examination, each horse was allowed to acclimate for 48 hours prior to the placement of a jugular catheter and the CGMS **(Figure 1)**. The CGMS uses a small flexible probe inserted into the subcutaneous tissue **(Figure 2)** using a unique method for determining interstitial glucose concentrations **(Figures 3 and 7)** Blood glucose (BG) readings were collected from the IV catheters using a Precision Xtra™ blood glucose monitor. Readings were taken an hour after initial placement of the CMGS and calibrations were performed 3 times daily throughout the experimental period. Horses were stall accommodated and fed a ration comprised of 2% of body weight as grass hay with ad libitum water for the first 24 hours period of CGMS monitoring. Subsequently and immediately, the horses were fasted for a period of 24 hours, receiving water only. The following day the horses were returned to the hay ration for a further 24 hours period of monitoring. On the last day of the study, horses were evaluated using a Combined Glucose Insulin Challenge Test (CGIT). The CGIT protocol consists of 50% IV dextrose at 150 mg/kg with simultaneous IV insulin administration at a dosage of 0.1 mL/kg using 100 mg/unit concentrations. Blood glucose levels were obtained using the hand-held glucometer (via IV catheter) at times 0, 5,10, 15, 25, 35, 45, 60, 75, 90, 105, and 120 minutes. This protocol was performed for another study but also served the purpose of evaluating CGMS response to rapid changes in plasma glucose. Upon completion of the study the CGMS was removed and the information downloaded. Each horse's average daily glucose concentration was compared via Student t-test as well as changes in interstitial glucose pattern between fasted and non-fasted days.

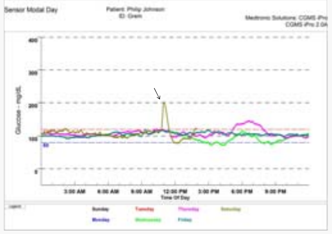

Figure 6: Composite of interstitial glucose levels from all days of probe attachment. Note remarkable change in glucose during CGIT challenge.

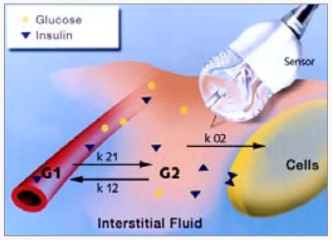

Figure 7: CGMS sensor sampling of interstitial glucose.

RESULTS/CONCLUSIONS

As demonstrated in the adjacent figures, there are slight changes in interstitial glucose patterns between the non-fasting **(Figure 4)** and fasting states **(Figure 5)**. The composite interstitial glucose pattern clearly shows an sustained increase in glucose with event of feeding on two days of recording but not the fasting day **(Figure 6)** In addition the interstitial glucose changes rapidly in response to administration of an intravenous glucose bolus **(Figure 6)**. The mean interstitial glucose concentration on the day of fasting was lower than the non-fasting day but less than 10% and not statistically significant (Data not Shown) These results suggest that there are slight changes in glucose in normal horses fasted for 24 hours. Future work will concentrate on studies using the CGMS and the dynamics of glucose homeostasis.

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