CASE STUDY

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Continuous Glucose Telemetry - New Insight into the Influence of Diabetes During Pregnancy

Introduction

Pregnancies involving preexisting or gestational diabetes occur in approximately sixteen percent of live births globally, each year. These cases require close monitoring of blood sugar levels throughout pregnancy and in the postpartum period. If not managed properly, severe complications including preeclampsia, preterm birth, neonatal respiratory depression, and stillbirth can arise.

Researchers sought to conduct a study on how glucose levels are impacted during pregnancy in both diabetic and normoglycemic states.

The Challenge

Rats are one of the most widely used animal models in pregnancy and metabolic research. Current methods for acquiring glucose measurements in animals are limited in the quality and quantity of data, due to increased animal stress and inadequate blood sampling methods. Because rodents are nocturnal, critical observation points including food intake, glucose levels and activity are all increased in the evening when data is not being collected. In addition, it is well understood that glucose metabolism follows a circadian rhythm and previous research has shown that increased circadian variability occurs in diabetic rats, in the absence of pregnancy.[+] Because of these limitations, researchers found intermittent sampling to be inappropriate when assessing the influence pregnancy has on blood glucose.

The Solution

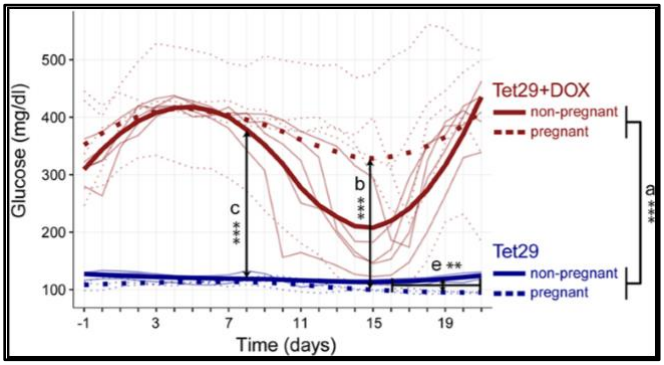
To overcome the challenges, researchers used the HD-XG telemetry implant to monitor rat blood glucose levels continuously for twenty three days. Sixteen Tet29 Insulin Receptor Knockdown female rats were separated into four experimental groups, which included a mix of diabetic (administered with doxycycline) or normoglycemic and pregnant or nonpregnant models. The glucose oxidase sensor was positioned infrarenally into the abdominal aorta and the implant body was sutured to the peritoneum. Core body temperature and activity were also recorded using the implantable telemetry device.

The Results

Chronic and continuous measurement of blood glucose and animal activity data provided researchers with the following new findings:

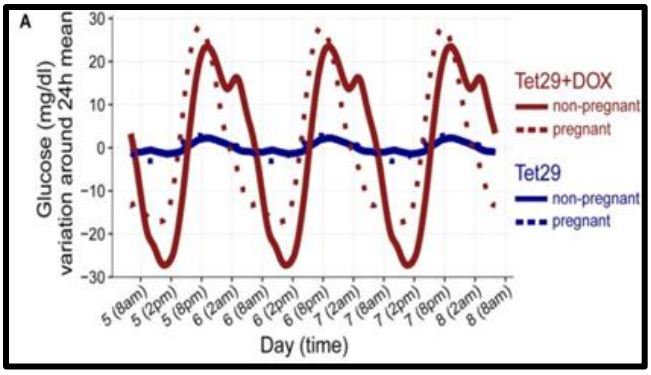
- Pregnancy in normoglycemic rats leads to a decrease in blood glucose levels during the later stages of pregnancy. In contrast, non-pregnant normoglycemic rats did not display this same decrease (Figure 1).

Figure 1: Continuous blood glucose measurements throughout study



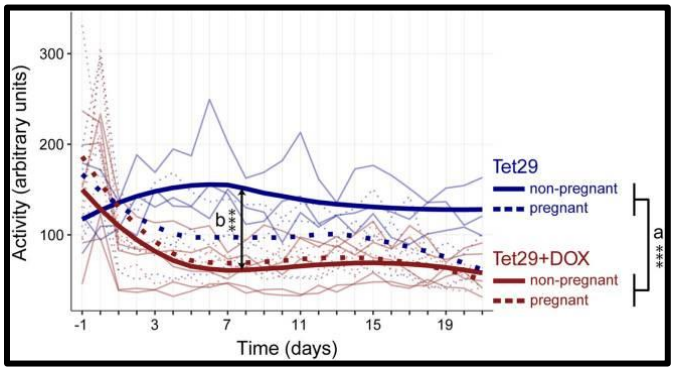
- Diabetic rats saw a much greater circadian variation in their mean blood glucose over the course of the study and pregnancy was found to decrease the variation of mean blood glucose in diabetic rats (Figure 2).

Figure 2: Diurnal variability of mean blood glucose days 5 - 7



- Activity was reduced in non-pregnant diabetic rats, while there was no significant difference in activity levels in pregnant rats, with or without diabetes (Figure 3).

Figure 3 : Activity levels



- Continuous glucose measurement allows for a smaller sample size to determine a given effect due to decreased variability and standard deviation.

The Successes

This was the first study done to assess diabetic and normoglycemic effects on pregnant rats using continuous blood glucose telemetry. The ability to collect continuous glucose data gave the researchers a first ever look into circadian glycemic levels over a twenty-three-day period in pregnant diabetic and nondiabetic models. The capability of telemetry to measure additional physiological parameters, like activity in a stress-free environment, showed the effects that diabetes has on activity levels. In addition, researchers were able to reduce the number of animals used owing to the increased statistical power achieved by using implantable telemetry and continuous sampling. The benefits seen with monitoring glucose continuously in preclinical models will allow researchers to gain new insight on how glucose levels differ during altered metabolic states or treatments, leading to improved patient outcomes.

DSI

DSI Data Sciences International (DSI) offers complete systems that sense, transmit, acquire, and report physiologic data. In order to create a more robust study design, scientists rely on DSI technology to study specific targets as well as obtain a holistic view; allowing them to look at side effects that are upstream or downstream of the main pathology.

The DSI team ensures that researchers are equipped and prepared from the first minute of their study to the last. With a fully staffed support team available to assist with technical support and training, data analysis, GLP validation, and surgical services, DSI is with you every step of the way; because your research is everything.

References:

[+]King AJ, Austin AL, Nandi M, Bowe JE. Diabetes in rats is cured by islet transplantation…but only during daytime. *Cell Transplant* (2017) 26(1):171–2. doi:10.3727/096368916X692258

Golic, M., Kräker, K., Fischer, C., Alenina, N., Haase, N., Herse, F., ... & Bader, M. (2018). continuous Blood glucose Monitoring reveals enormous circadian Variations in Pregnant Diabetic rats. *Frontiers in Endocrinology*, *9*, 271.