

Effect of glucose/insulin on equine vascular endothelial glycocalyx

CM Veterinary Research
Scholars Program
University of Missouri

Kexin Fang¹, Kile S. Townsend¹, Lynn M. Martin¹, Francisco Ramirez-Perez², Christopher A. Foote², and Philip J. Johnson^{*1}

1. Department of Veterinary Medicine and Surgery, College of Veterinary Medicine, University of Missouri, Columbia, MO.

2. Department of Medical Pharmacology and Physiology, University of Missouri, Columbia, MO.

Background

• **Laminitis** is a common and potentially devastating disease of horses (Fig 1.), primarily resulting from either sepsis or insulin dysregulation (ID).



Fig 1.

• **Microcirculatory dysregulation** is important in laminitis pathophysiology. (Fig 2.)

Fig 2.

• **Endothelial glycocalyx (EG)** (Fig 3.) damage is increasingly being recognized as a pivotal contributor to microcirculatory dysregulation.

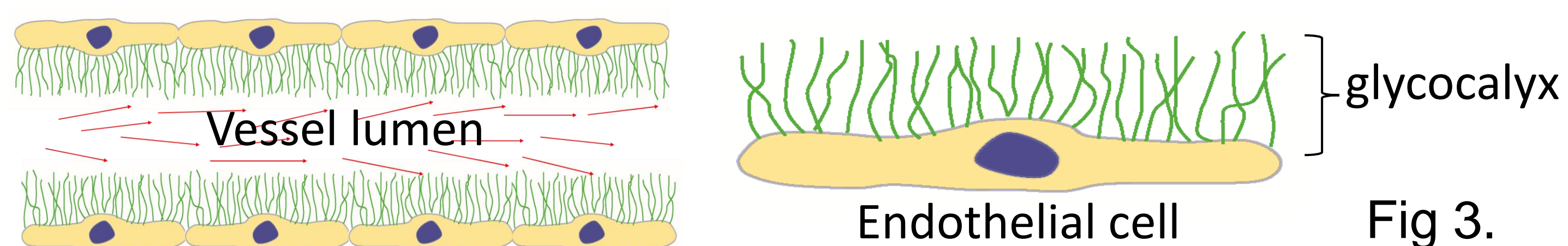


Fig 3.

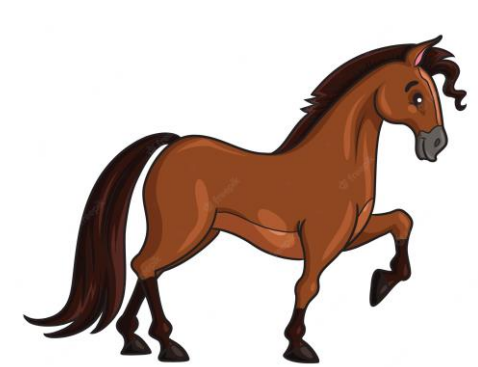
• We have already demonstrated that EG degradation occurs in some horses with sepsis. However, whether EG degradation occurs in the setting of elevated plasma glucose/insulin (ID) remains unknown.

Hypothesis

• Elevated glucose/insulin levels promote EG degradation.



Methods



X8

Three standardized tests of equine glucose/insulin dynamics:

I.V. Glucose tolerance test



0.5 g/kg
Dextrose

Oral sugar test



0.45 mL/kg
Karo Syrup

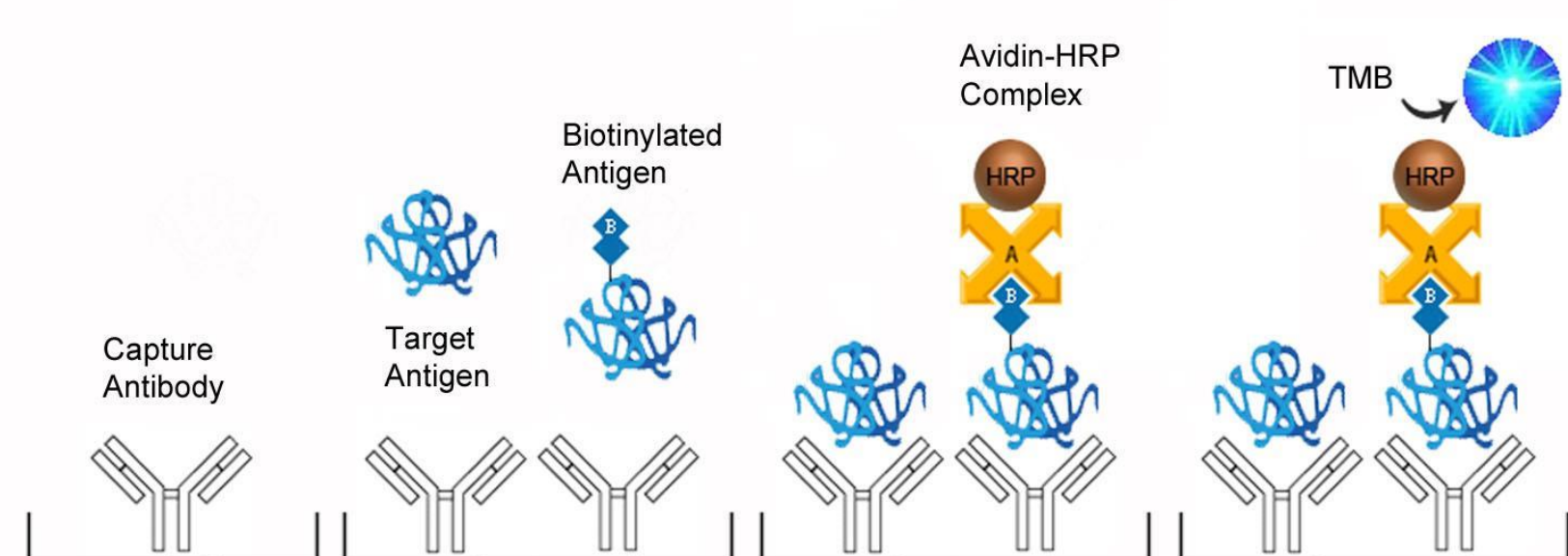
Insulin tolerance test



0.1 U/kg
Humulin R

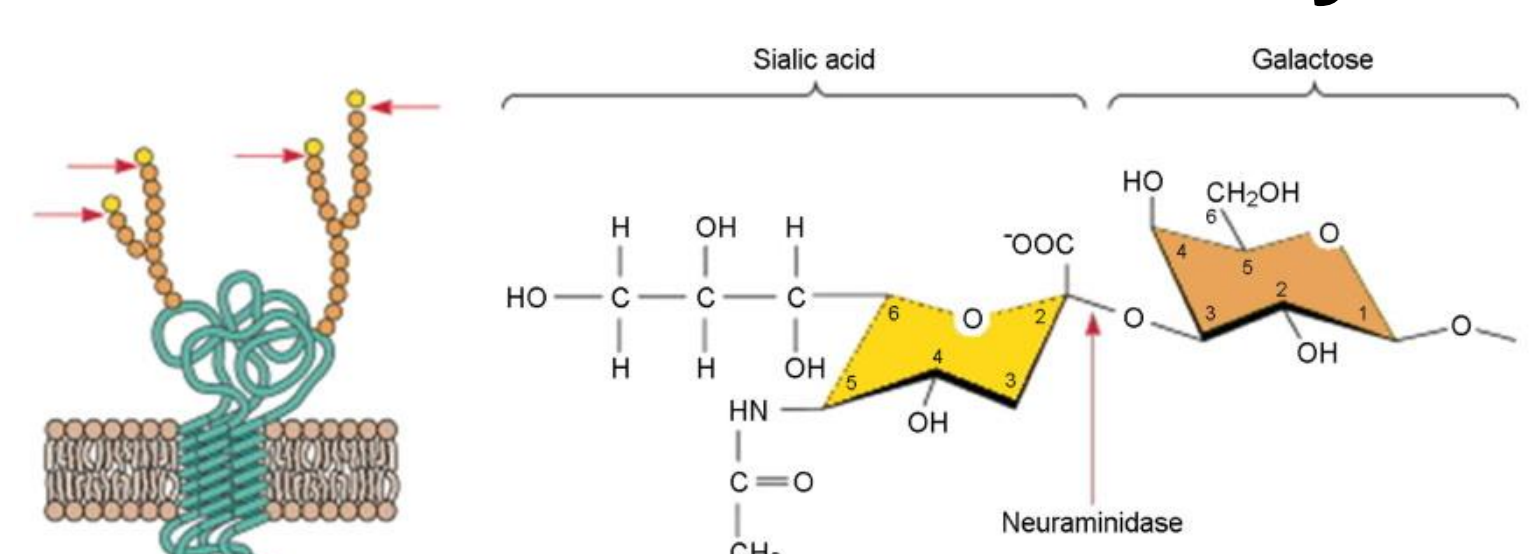
Blood collection at 0, 60 and 120 min, then:

a. Hyaluronan Quant ELISA:



Hyaluronan is a component of endothelial glycocalyx.

b. Neuraminidase activity assay



Neuraminidase is a glycocalyx-degrading enzyme.

c. Neuraminidase 3 Quant ELISA

Results

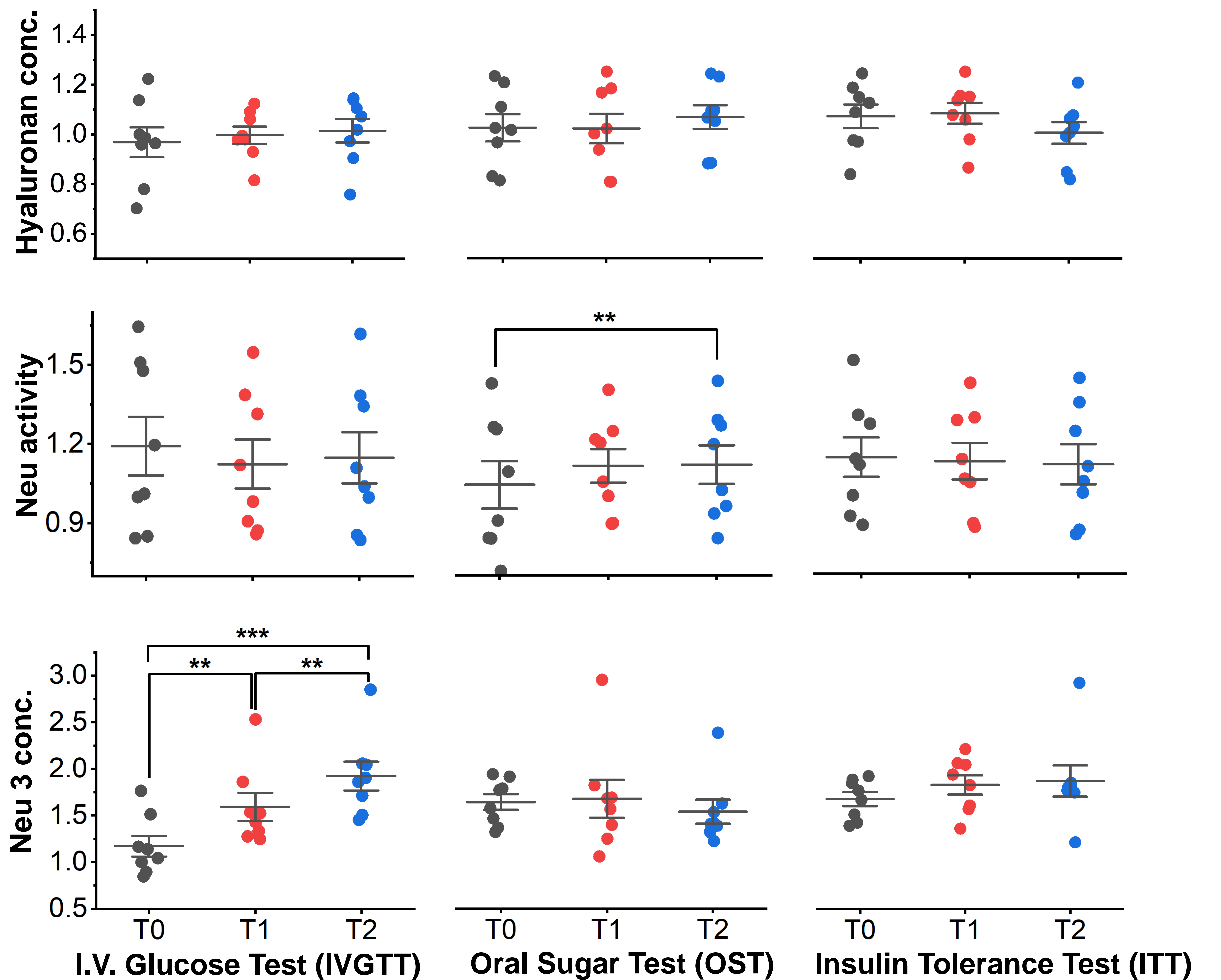


Fig 1. Hyaluronan concentration, Neuraminidase activity and Neuraminidase 3 concentration at 0 (T0), 60 (T1) and 120 (T2) min of IVGTT, OST and ITT. All data are normalized.

Conclusions

- Under the experimental conditions, hyaluronan concentrations were not significantly different across all three tests. Neuraminidase activity at T2 was significantly greater than T0 in the OST. Neuraminidase 3 concentration significantly increased over time in the IVGTT. These results imply that EG degradation is promoted in hyperglycemic horses.
- One of the horses was found to be diabetic incidentally in the process of this study. The glucose and insulin levels of this horse were substantially higher than reference ranges. Interestingly, neuraminidase 3 concentrations in this horse also far exceeded the other horses.
- There was no significant difference in day-to-day glucose and insulin baseline levels.
- Plasma insulin levels did not increase during the ITTs, which is counterintuitive and needs further study.

Acknowledgments

Funded by the Animal Health Foundation of St. Louis. We are grateful to colleagues at the Veterinary Health Center for their assistance with treatment and care of horses.