Using Cardiovascular and Aerospace Medicine to Understand the Mechanisms of Snake Constriction

Abstract:

How a predator effectively kills its prey plays a key role in predator-prey relationships, and has been an important factor in the evolution of every species, including snakes. Specifically, the multitude of methods that snakes have evolved to incapacitate their prey has partially offset their seemingly disadvantageous limbless form. Constriction behavior has played a key role in their evolution and success and involves the wrapping or winding of their body around prey while contracting their muscles. Although our understanding of how constriction effects prey has changed over the last century, not all hypotheses have been thoroughly tested. The known hypotheses underlying the mechanisms of constriction currently include suffocation, cardiac arrest, blunt force trauma, and neural damage. Further, current research suggests that ectothermic animals (amphibians and reptiles) are not susceptible to many of the known constriction mechanisms. However, current research does not easily explain how constricting snakes are able to quickly disable and feed on ectothermic prey. A recently raised hypothesis (the red-out effect) states that some prey animals may be experiencing high pressures in their heads during constriction, effectively shutting down their nervous system. This hypothesis has never been tested but potentially explains how some constricting snakes can kill other reptiles. Here, we seek to quantify the cranial pressure in prey that are constricted by snakes. To do this, a Harvard Pressure Transducer will be attached via a fluid filled system to the cranial cavity of the mouse. When constriction is initiated the pressure exerted on the body will be transferred to the skull where it will be recorded. This would provide evidence for the red-out hypothesis and provide the first quantitative evidence of pressure in the cranium during constriction. Further, we aim to compare the constriction performance of snakes feeding on both lizards and mammalian prey in order to better understand this dynamic predator-prey interaction.