

Wrestling with the alligator's brain

When some individuals stand up quickly from a sitting or crouched posture, the blood flow to their brain is temporarily reduced. In response to the reduced blood flow, their brain will enter a short period of neural shock leading the individual to faint, a condition called Syncope. Alligator shows, and alligator wrestling, have been popular tourist attractions for over a century. Often during alligator wrestling the alligator is rolled over and briefly held in this belly-up posture. Typically, this induces a condition in alligators called tonic immobility during which the animal exhibits flaccid paralysis and appears to be unconscious; in other words, the alligator looks like a human who has fainted.



Fig. 1. American alligator (*Alligator mississippiensis*) in the tonic immobility posture; photo courtesy of Kelly Rogers and Bruce A. Young.

Tonic immobility is rather common in animals, and is normally induced by rolling the animal (be it a crab, rabbit, or shark) belly-up for a short period. There remains considerable debate about what causes tonic immobility. Our research was undertaken to determine if tonic immobility in the alligator was essentially the same as syncope, and was due to changes in blood flow to the brain.

Why look for this connection in the alligator? Alligators have the most dynamic pattern of blood flow through their heart; the alligator can consciously redirect blood between the lungs and body, and between the head and the rest of the body. Perhaps tonic immobility or syncope was simply an unusual consequence of the variable patterns of blood flow in the alligator heart? We tested this in two steps. First, we took an MRI of a resting alligator's heart, then wrestled it into tonic immobility and quickly took a second MRI while the alligator was still in the belly-up posture. Comparing the two MRIs revealed that when the animal was rolled over the heart shifted significantly in the alligator's body cavity. This wasn't surprising; the human heart bounces around in our chest as we jog, and reptile hearts are more mobile than human hearts. But did this change in heart position change blood flow to the brain? The second step of the study involved answering this question, and we did this using Doppler ultrasonography. With this technique we could visualize and measure the blood flow through the alligator's heart, and in the alligator's carotid artery (which carries the blood to the brain) while the alligator was in both the relaxed and belly-up postures.



Fig. 2. During tonic immobility the alligator appears unconscious and exhibits flaccid paralysis.

We found that when the alligator was rolled onto its back and its heart shifted in its body, there was a significant change in the blood flow pattern through the alligator's heart. One consequence of

this altered blood flow in the heart was that significantly less blood was flowing through the carotid artery. So rolling the alligator over resulted in a distinct reduction of blood flow to the alligator's brain, very similar to the situation that can happen when a person stands up too quickly. This led up to conclude that tonic immobility in the alligator is a specialized form of syncope or fainting.

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[Hemodynamics of tonic immobility in the American alligator \(*Alligator mississippiensis*\) identified through Doppler ultrasonography.](#)

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