Hibernation study yields insights about organ protection

June 22 2016, by Marie Thoms

Novel adaptations discovered in hibernating animals may reveal ways to mitigate injuries associated with strokes, heart attacks and organ transplants, according to researchers at the University of Alaska Fairbanks and Duke University.

They described the adaptations in a paper published in the June issue of the journal *Anesthesiology*.

"This has been an important and exciting partnership that promises transformative changes to how trauma and surgical care are provided," said Brian Barnes, study co-author, long-time hibernation researcher and director of the UAF Institute of Arctic Biology. "It comes from a better understanding of how Arctic ground squirrels and black bears overwinter in Alaska."

A person typically takes a long time to recover from cardiac surgery or organ transplant. This is in part because organ tissue is damaged when blood flow ceases or is reduced when a heart stops or an organ is removed. Tissue is also damaged when blood flow is restored and the body's metabolic machinery is not able to safely handle the returning rush of oxygenated blood.

Protection of tissues following cardiac arrest or organ transplant has remained an elusive scientific target, despite significant research and promising data.

In 2009, Barnes, a zoophysiologist, and Dr. Mihai Podgoreanu, chief of Duke's Division of Cardiothoracic Anesthesiology, began collaborating to identify how a hibernating Arctic ground squirrel's heart can survive what is akin to repeated cardiac arrests.

Unlike other animals, Arctic ground squirrels can lower their metabolism to 2 percent of their normal rate, which allows them to essentially shut down bodily functions they don't need and, importantly, puts their organs in a state of suspended animation.

Barnes, Podgoreanu and colleagues from Duke and UAF collected and analyzed proteins associated with heart muscle from cooled, hibernating Arctic ground squirrels in which blood flow had been stopped. They repeated the analyses on heart proteins from active summer Arctic ground squirrels and rats, which don't hibernate.

By comparing the various proteins produced and the metabolic changes within each animal, they identified novel internal adaptive mechanisms by which ground squirrels cope with cold and other stressors and how those mechanisms relate to blood flow problems associated with cardiac surgery.

One such mechanism is the ability of hibernators to exclusively use lipids, which include fats, vitamins and hormones, as metabolic fuel instead of burning carbohydrates, as humans do during surgeries.

Understanding this unique model of extreme metabolic flexibility may help scientists develop strategies that enable doctors to "switch" the metabolism of a patient who has suffered a stroke, cardiac injury or hypothermia to resemble that of a hibernator and thereby improve survival and recovery.

The authors anticipate that the knowledge gained from this study could

be applied to organ protection in nonhibernators and ultimately in patients undergoing heart surgery and transplantation, and for victims of cardiac arrest, trauma and hypothermia.

More information: Quintin J. Quinones et al. Proteomic Profiling Reveals Adaptive Responses to Surgical Myocardial Ischemia–Reperfusion in Hibernating Arctic Ground Squirrels Compared to Rats, *Anesthesiology* (2016). DOI: 10.1097/ALN.0000000000001113