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Scientific Research and Essays

Eco- and Neurophysiology Session

Long-term biologging of physiological variables as a method to investigate the capacity of large terrestrial mammals to cope with climate change

A. Fuller[1], D. Mitchell[1], R. S. Hetem[1] and S. K. Maloney[2]

[1]Brain Function Research Group, School of Physiology, University of the Witwatersrand, South Africa.
[2]School of Biomolecular and Chemical Sciences, University of Western Australia, Australia.

20 December 2011

Uncovering the physiological plasticity available to long-lived terrestrial mammals to cope with predicted effects of climate change requires the measurement of physiological variables in free-living animals. We have used biologging to measure variables such as core body temperature, selective brain cooling, respiratory evaporative heat loss, microclimate selection, vasomotor state, orientation behaviour, and locomotor activity in animals in their natural habitats. In the face of increasing environmental heat load and aridity, large mammals may select cooler microclimates and shift activity from day to night, as we have shown for Arabian oryx and black wildebeest. Selective brain cooling, which inhibits evaporative heat loss and conserves body water, also may offer a key adaptation for artiodactyls, such as sheep and antelope, in a climate-changed future. It also has been proposed that heterothermy allows large mammals to conserve body water, by storing heat during the day. However, we have shown that such heterothermy reflects a failure of homeothermy, mainly as a result of dehydration and starvation. Most studies report data collected for less than a year, but we need prospective long-term data collection if we are to determine the phenotypic plasticity available to animals to cope with the thermal stress, aridity, food shortage and emerging pathogens consequent on climate change and anthropogenic land transformation. Long-term biologging provides a sophisticated tool for obtaining a mechanistic understanding of species' responses to environmental variability.

Key words: Climate change, biologging, body temperature, heterothermy, homeothermy, mammals.

Avian fever: A role for thyroid hormone in the susceptibility of birds to climate change

M. Marais[1], S. K. Maloney[2] and D. A. Grey[1]

[1]School of Physiology, University of the Witwatersrand, Johannesburg, South Africa.
[2]Physiology, School of Biomedical, Molecular and Chemical Sciences, University of Western Australia, Australia.

20 December 2011

Although fever is considered an evolutionary conserved immune response to pathogenic infection there are differences in the characteristics of avian and mammalian febrile response. These differences might be due to variations in the physiological mechanisms that underlies fever in these phyla. We studied the role of thyroid hormone in activating meta-

bolic heat production in Peking ducks made febrile with bacterial endotoxin. Sixty minutes after injection of lipopolysaccharide, ducks had a significant increase in the concentration of plasma thyroxine (T_3) and this rise in T_3 was equivalent in ambient temperatures within, or higher, than the duck's thermo-neutral zone. We conclude that activation of the innate immune response in Peking ducks results in a release of thyroid hormone. We think this augments metabolic heat production, which in turn, mediates fever. As the increase in plasma T_3 is unaffected by ambient conditions, the amount of metabolic heat produced during febrile mediation if ducks, seems to be consistent. In hot environments this results in augmented fever that become detrimentally high. Our findings differ from the physiology of the mammalian febrile mechanism, and we propose that this variation in the avian febrile mechanism makes birds vulnerable to conditions of climate change.

Key words: Thyroid hormone, fever, plasma thyroxine, avian febrile mechanism.

In vitro cytotoxic analysis of methamphetamine on mouse brain endothelial (bEnd5) cells

T. K. Prinsloo, K. Gamieldien and D. Fisher

Department of Medical Biosciences, University of the Western Cape, Bellville, South Africa.

20 December 2011

Methamphetamine (MA) is a powerfully addictive psychostimulant which is a popular illicit drug, world-wide second only to cannabis. MA is an indirect agonist of dopamine and its abuse results in neurodegenerative changes in the human brain. Mouse brain endothelial (bEnd5) cells have been proposed as an efficient *in vitro* model for the blood-brain-barrier (BBB). In order to use bEnd5 cells as an *in vitro* model this study focused on establishing the IC_{50} of MA. These preliminary studies aimed to create foundations for future *in vitro* MA analysis on the bEnd5 cells. Lactate dehydrogenase (LDH) assay was used to determine % toxicity. Trypan blue and MTT assays were employed to determine cell viability and percentage cell growth for the various MA concentrations at selected time intervals in order to establish IC_{50}. The Wilcoxon Rank Sum Test was used for the statistical analysis. $P<0.05$ was designated as significant. The results showed that percentage viability for controls were similar to experimental cells at all time intervals and/or MA concentrations (98.50±1.76). There was a 204-fold increase ($P=0.0253$) in cell growth between 24 and 96hrs for controls while, MA-exposed cells displayed only a maximum of 134.5-fold ($P\leq0.0209$) increase in cell growth. Cells exposed to MA displayed biphasic activity for all time intervals. 48 h MA exposure resulted in a significant growth increase for all concentrations compared to controls ($P\leq0.0253$). In contrast, at 96hrs there was noticeably lower cell growth for all MA-exposed cells when compared to controls. Viability was not affected by MA exposure and no toxicity was observed for all MA concentrations and time intervals analyzed ($P\geq0.05$). MA exposure did not induce cytotoxicity and thus IC_{50} could not be determined for the selected concentrations and time intervals. Exposure to pure MA had no effect on cell viability but resulted in significant suppression of bEnd5 cell growth.

Key words: Methamphetamine, blood brain barrier, bi-phasic activity, cell growth.