Case for the Fevered Saurians

Terrestrial higher vertebrates (and some aquatic ones) maintain thermal homeostasis around 37° Celsius (= 98.6 Fahrenheit). Some of us do it all the time and so are called homeotherms (birds and mammals). Some do it only some of the time and are called poikilotherms (reptiles). Some of us (birds and mammals again) get most of the heat energy to stay warm from internal metabolic sources and are called endotherms. Some (reptiles) depend on external sources like solar radiation or warm objects and are called ectotherms.

Endotherms can vary the rate of heat release from metabolic activities and thus adjust physiologically to changing environmental conditions. Ectotherms can only change position and orientation to the sun and warm or cool objects and thus adjust behaviorally to changes in the environment, but they are very good at it. Once warmed up in the morning their body temperatures vary little more than ours during the course of the day. Physical exertion can elevate our temperature; inactivity in a cold location can bring it down. Normally mechanisms like sweating or shivering respond quickly and keep our temperature stable. Lizards can choose shade or sun as needed to achieve similar stability; they have elegant circulatory mechanisms to move heated blood around their bodies just as we do.

So why would a homeostatic animal whose enzymes are evolved and adapted to function best at 37° C chose to elevate its temperature to 40° C? Is being feverish a good thing? What benefits are associated with a fever? What risks are associated with a fever?

Physicians dating back to the Greek Hippocrates (as in Hippocratic Oath) believed that fever was a good thing, which became the basis for warming therapy. The practice continued for most of two thousand years until the first part of this century when fever came to be viewed as an unwanted and harmful side effect of illness. Fevered patients were cooled with damp cloths, cold baths and even ice. When it was noticed that aspirin reduced a fever, it was often given in liberal amounts to lower body temperature.

New information suggests that Hippocrates was onto a good thing. Elevated body temperature improves the efficiency and performance of the body's immune response to infection. An early demonstration of this was made in the early 1970's by Dr. Matthew Kluger working with lizards.

He began with healthy lizards in an environmental chamber that contained a range of different temperatures. They moved about until they found a spot that they seemed to prefer.

Q: Where would you predict the lizards would tend to hang out? And why there?

Having established the preferred temperature for healthy lizards Kluger then infected them with bacteria and observed that they moved to warmer areas of the chamber. Their new preference was for 40°C.

Q: What do these results suggest? Is fever a desirable thing when infected?

Q: If Kluger wanted to test the hypothesis that the induced fever is beneficial to the lizards, what should he have done next?

What Kluger then did was to infect several groups of lizards with the same bacteria. One group he held in a chamber kept at the temperature they normally preferred (38°C). A second group was kept at 40°C. After one week the health of the lizards was assessed.

Q: If Kluger's hypothesis was correct, what differences should he have seen in the two groups of lizards infected with potentially lethal bacteria?

Seven days after infection 75% of the lizards held at 38°C had died. Only 25% of the lizards kept at 40°C had died.

Q: What conclusions can we make about the effect of fever in lizards?

Q: What conclusions can be made about the effect of fever in humans?

Q: What does this case tell us about the advisability of using aspirin when we have a mild fever associated with an illness?

Q: What does this case tell us about the use of hot baths and the consumption of copious quantities of hot beverages at the onset of a cold or sore throat?

Q: What does this case tell us about fevers in excess of 40°C (104°F)?

Q: Why are high fevers considered a problem?

Q: Would lizards and people stay healthier if they kept their temperatures at 40°C all the time?