Comatose locusts may help relieve migraines

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The way locusts react to stress may provide an important clue to understanding what causes human migraines – and how to reduce their painful effects, says Queen's University Biology professor Mel Robertson.

With PhD student Corinne Rodgers, Dr. Robertson is using insect models to examine how the nervous system controls breathing when stress is induced through high temperatures and oxygen deprivation. They have discovered that the locust's reaction to extreme heat is very similar to a disturbance in mammals that has been associated with human migraines and stroke.

As a way of temporarily shutting down and conserving energy when conditions are dangerous, the locust's coma has many of the same characteristics seen in people at the onset of a migraine. "We feel there may be an evolutionary link between the two," Dr. Robertson suggests.

His team's findings are published on-line in the journal *PLoS ONE.*

The study monitors locust breathing cycles, which are controlled by a collection of nerve cells in the central nervous system. With heat or lack of oxygen, the insects initially breathe more quickly and then go into a coma. They recover when the temperature comes down again, or oxygen levels rise.

"We find that the point of coma is always associated with a surge of extra-cellular potassium ions: the same as has been observed in human

brain tissue during surgery," says Ms Rodgers. For the nervous system to work properly, potassium should be high inside cells and low outside, she points out. "What we're seeing is a failure of that ability to maintain this equilibrium – but in fact, in the locust, it appears to be an adaptive response to protect the system."

Also on the Queen's team are students Gary Armstrong and John LaBrie, research assistant Kelly Shoemaker and Biology professor Chris Moyes.

Previous research in Dr. Robertson's lab has shown a genetic component to this response, which indicates there may be an evolutionary link to what happens during migraines in people. "It's possible, for example, that the brain architecture necessary for increased sensitivity also predisposes areas of some people's brains to become over-excited, and that migraines provide a means of temporarily 'shutting things down,'" he suggests.

While migraine has been associated with this disturbance for some time, the mechanisms underlying the phenomenon are not yet well understood. And that understanding will be key to designing new migraine treatments.

"We found that we could precondition the locust system to be more stress-tolerant. If the mechanisms are the same as those in humans, then similar manipulations could help to protect brain function under stressful conditions, such as those leading to migraine," says Dr. Robertson.

"Something is triggering events like this," he adds. "Maybe we can just bias that slightly, so it won't trigger as often, or the consequences will not be as severe."

The Queen's team has two joint patent applications under way: one to manipulate cellular pathways to mitigate the effects of high temperatures

on the brain, and the other to manipulate pathways for migraine therapy.

Source: Queen's University