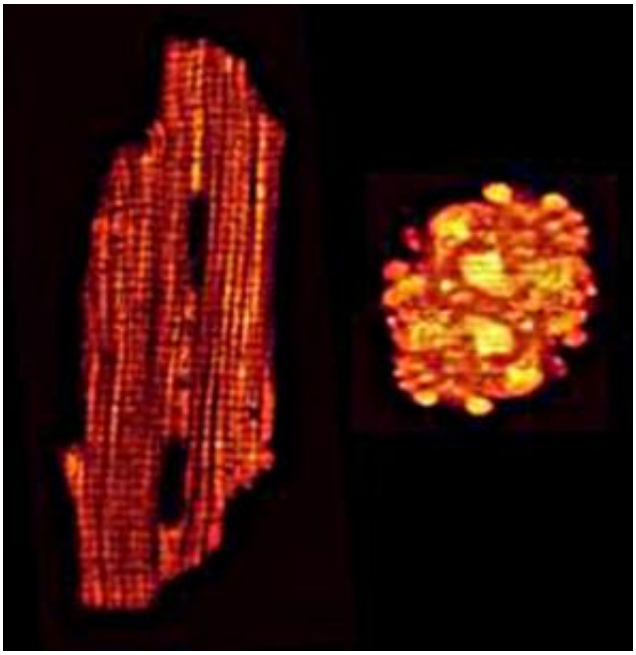
Lighting up the heart

September 22 2006



Live and dead heart cells. Credit: Elinor Griffiths

A major breakthrough in research could lead to improved recovery of the heart when it is re-started after a heart attack or cardiac surgery.

For the first time ever, researchers at the University of Bristol have been able to directly measure energy levels inside living heart cells, in real time, using the chemical that causes fireflies to light up.

Dr Elinor Griffiths said: "Being able to see exactly what's going on in heart cells will be of great benefit to understanding heart disease."

The research is published today (22nd September, 2006) in the *Journal of Biological Chemistry*.

The 'power stations' within heart cells that make energy are called mitochondria. They convert energy from food into chemical energy called adenosine triphosphate, or ATP.

Under normal conditions, mitochondria are able to make ATP extremely rapidly when the heart is stressed, such as during exercise or in "fight-or-flight" mode.

However, if the cells are made to beat suddenly from rest, a situation that happens when the heart is re-started after cardiac surgery or a heart attack, the team found there is a lag phase where the supply of ATP drops before mitochondrial production starts again, potentially preventing the heart from beating properly.

The researchers made use of a protein called luciferase, which is normally found in the tails of firefly and is what causes them to light up. Using molecular biological techniques, they transferred modified forms of the luciferase DNA into heart cells – the cells could then make their own luciferase, and the modifications enabled the luciferase to be produced inside the mitochondria.

Since luciferase lights up in the presence of ATP, the amount of light, and hence the amount of ATP, could be detected using a microscope and a highly sensitive camera.

Dr Griffiths explained: "The breakthrough presented by this technique could be of benefit in heart diseases where mitochondria cannot make enough ATP. When that happens the heart does not have enough energy to perform its function of pumping blood efficiently which can result in a heart attack."

Exactly how mitochondria tailor the supply of ATP to demand is not fully known. Being able to directly measure ATP levels inside mitochondria of living heart cells in real time will go a long way towards understanding this more fully.

Source: University of Bristol