Circadian = 24-hour biological rhythms that most of us know about

Ultradian = Rapid biological rhythms, that cycle several time per day, e.g. with period in the 2-8 hours range.

Script

Most of us know from experience that our bodies have natural rhythms that affect us in many different ways over the course of a day .. We usually wake up in the morning and go to sleep at night, for one obvious example. Some of us will feel sharp in the morning and others will be more alert in the afternoon, but there will be a pattern. These 24-hour rhythms are called circadian rhythms, and we have discovered that they are driven by molecular clocks at work in every cell of our body.

It is now well known that disturbing these circadian rhythms - by shift working as some nurses do for example - can be bad for your health. It can increase the risk of becoming obese, and diabetic, and becoming depressed.

What is much less well known is that that our bodies also have natural rhythms that are shorter than 24 hours. Rhythms that may cycle over a few hours. In us, we see stress hormones go up and down several times a day. Another example we are not usually aware is that we cycle though deep and dream sleep several times in any night.

We call these fast rhythms ultradian rhythms, and we know almost nothing about them, even though they are always there.

The work we do here with voles is all about understanding how these fast ultradian rhythms are controlled. Are there cellular clocks that control the rhythms in a similar way to the circadian, 24-hour, clocks? Or are they completely different? To find out we work with people in our sleep labs, we grow cells, and we study voles.

Why voles? Well, voles happen to have very strong ultradian rhythms. Typically they are awake for an hour and a half, then sleep for an hour, and then wake again. This routine continues day and night, so in many ways, their day is only 2 and a half hours long. In fact, their ultradian rhythms are so strong that it is almost impossible to detect any circadian rhythms. Voles show very strong ultradian rhythms, but in fact all animals, including us, show ultradian rhythms.

So what exactly do we do with these voles. Well, to begin with we looked at what changes in their bodies during their normal ultradian day. For instance, we took pin pricks of blood from their tail to measure changes in the electrical properties of their blood cells over an ultradian day. We have also surgically places brain electrode into some voles. These electrodes wirelessly transmit information about the activity of the brain, without interfering with the voles normal behaviours such as eating, sleeping and socialising. But to find out what happens inside the cells of the voles, we sometimes put them down, and remove cells and tissue to look at in detail.

So far, in our human, vole and cell experiments, we have discovered that ultradian rhythms operate independently of circadian rhythms. In cells we know that about 10% of genes have an activity patterns that is circadian, and there are other genes, that shown an ultradian activity pattern of just a few hours. We can get voles to shift their feeding times, by when we give them food. This changes their ultradian behaviour, and is matched with changes in the expression of some genes in the liver.

We are still looking for the clock the drives these ultradian rhythms. We have learnt that these rhythms can be seen in the cell's metabolism, and we see them in the every day behaviour of

the vole. Whilst this narrows it down, we still are not a point where we understand these rhythms in full, and what their role is in health.