Postgraduates

Two of our post-graduate students describe their research projects.

Arthritis in a Dish

SAMPURNA CHAKRABARTI

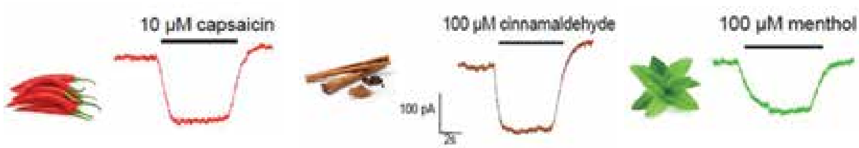
When I was growing up, three out of my four grandparents hobbled around the house with swollen knees, slightly limping and blaming the winters of Kolkata for triggering their arthritis. There was no specialised treatment for them, except for over-the-counter painkillers, like paracetamol and ibuprofen, on especially painful days. Like the other 1.4 billion people worldwide with some form of arthritis, they were resigned to the fate of living with the ebb and flow of chronic pain.

One of the major challenges in developing effective, targeted therapies for treating arthritic pain is the poorly understood link between inflammation and pain – the two hallmarks of the disease. What we perceive as "pain" is the combined effect of a series of changes in our psychological, behavioural and cellular states. However, technical limitations restrict in-depth research of all the levels simultaneously. Therefore, during my PhD, I am focusing on the cellular understanding of how inflammation translates to pain.

In a healthy knee, there are cells called fibroblast-like synoviocytes (FLS) that line synovial joints (e.g. hip, knee and shoulder) and keep them lubricated. In arthritis, the FLS increase in number (manifested as inflammation) and release chemicals that activate the nerve endings in the joints. The nerves transmit this information to the spinal cord and then finally to the brain to give rise to the sensation of pain. At a cellular level, nerves primarily detect painful heat, cold, chemicals or touch through expressing proteins that are activated by these different stimuli. Therefore, in my research, FLS are the model for inflammation and nerves (near the spinal cord) are the model for pain.

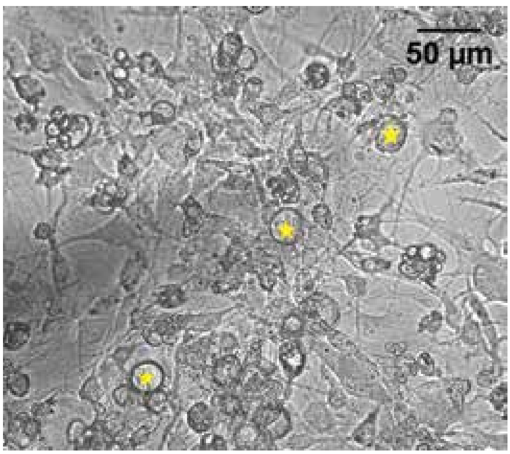
To study the elusive link between inflammation and pain, I use two groups of mice – a healthy group and an arthritic group. From these groups, I record the activity of FLS and nerve cells in response to "painful" chemicals like capsaicin (the chemical found in chilli peppers that gives them their hot taste), cinnamaldehyde (giving the burning taste of cinnamon) and menthol (derived from mint and producing a cooling sensation).

So far, by recording the activity of healthy FLS and nerve cells individually, I have found that both can respond to capsaicin, cinnamaldehyde and menthol; and in FLS and nerves taken from arthritic mice, more nerves respond to these "painful" chemicals. These findings suggest that heat and cold detecting proteins might be the mode of communication between FLS and nerves and hence, between inflammation and pain.



Typical responses of nerves to chilli extract, cinnamon extract and menthol extract respectively; a change in electrical activity upon application of the different chemicals represents activation of a cell.

But, how can we show that FLS directly communicate with nerves? I plan to do this by re-creating arthritis in a dish: nerves will be grown on top of FLS, mimicking a joint environment. If FLS from arthritic mice can make the healthy nerves respond more to the "painful" chemicals, we will find the link between inflammation and pain which might help to identify novel drug targets.



"Arthritis in a dish": Nerve cells (marked with yellow stars) on a bed of FLS from the knee.

My research may not cure arthritis during my grandparents' lifetime. However, it will hopefully contribute to the dream I share with Facebook co-founder Mark Zuckerberg and his pediatrician wife Priscilla Chan that we will be able to "cure, prevent or manage all diseases in our children's lifetime".

Sampurna Chakrabarti

Resilience to drought in East Africa

Peadar Brehony

Peadar's PhD research is partially supported through small grants from the Department of Geography, The Nature Conservancy, Corpus Christi College and the Mary Euphrasia Mosley Fund. Peadar is supervised by Professor Nigel Leader-Williams.

Dust devils swirl around, whipping up what's left on the parched land. Emaciated carcasses dot the landscape: a cow, a zebra, a sheep, a wildebeest. People like Albert Kipanoi are taking extreme measures to survive, pulling their children out of school because they can no longer afford it, or to help look after the weak livestock. Others have travelled huge distances, at great expense, to access food and water. When the delayed rains do finally arrive, they quickly transform the landscape to one which is vivid green and alive, teeming with wildlife, livestock, and Albert's happy family.

This is the story of East Africa's rangelands where droughts are periodic occurrences. These rangelands are also globally renowned for their large mammal wildlife and conservation areas. However, significant changes in the social and ecological systems have occurred over the last few decades. This is the focus of