Brain Changes in Chronic Pain Patients

Now another aspect, another thing about chronic pain patients that we've discovered, we and a number of other people have shown over the last 10 years now, is that chronic pain patients have changes in the brain, in the anatomy of the brain, particularly brain gray matter, as well as—I'm not going to go into this, but also in terms of white matter connectivity—but that there seems to be major anatomical changes in the brain when a person has had pain for a long time. This shows an example of now these colors are not meaning activation, these colors are representing regions where the cerebral cortex is thicker in the healthy control subjects than in the subjects that have had back pain. And you see all this blue are all areas mainly in the frontal cortex and the dorsolateral, ventral lateral, medial, and insula and anterior cingulate cortex, all through this whole frontal lobe of regions where people have had back pain and controls matched on all the other relevant variables that might affect the gray matter of your cortex, they have thinner cortices than do matched controls. And this has been—and if you see particularly the areas where you see this cortical thinning is mainly in these parts of the brain that we think are involved in some of these descending modulatory systems. And this has been shown in lots of different chronic pain conditions now.

Another condition that's interesting in that there's no obvious physical insult leading to it, which is fibromyalgia. Fibromyalgia is a chronic widespread pain condition. It's been characterized—it's kind of changing, fibromyalgia, docs are kind of changing their opinion about how to characterize it. Traditionally it's been characterized by having muscle tenderness, and these are where they call tender points. You press on these various points of the body just enough pressure so that your thumbnail blanches, and if that's painful. For healthy people, it's generally not painful, and for people with fibromyalgia, they would have—I think the criteria is 11 of 18 points; but basically you tend to have almost no points or all the points as being tender. But if you look at these fibromyalgia patients (and again I don't have time to go through all of this) there's been studies showing that, in fact—activation studies showing, in fact, when they say something is painful, the brain is responding as if it's painful. So that there's real—there's some real evidence that, in fact, they are experiencing pain. But as with the back pain patients, these are showing regions of the brain—this is from Marta Ceko's data showing that, in fact, there are multiple areas again mainly in this prefrontal cortex, dorsolateral prefrontal, medial prefrontal, ACC, that, in fact, are thinner in the fibromyalgia patients compared to their match controls. Again, these descending modulatory systems. The story is not as simple as we would like it to be, of course. And in this particular study we're seeing, in fact, and other studies that go back to literature, we start reanalyzing data based on age, we're finding that these effects are happening mainly in the older patients. So here if you plot age by cortical thickness in these various areas, we find here are the healthy people in open circles. And for the younger patients, there's not really a difference, but when they get older, there seems to be an age-related decrease in gray matter in the brain which seems to be accelerated in the chronic pain patients—even independent of how long they've had pain, which is shown here with the duration. So it seems that we do have a normal age-related loss of gray matter which seems to be accelerated in a chronic pain patient.

Okay. So psychologically based therapies, can these protect against these anatomical changes that we're seeing in chronic pain patients? And the evidence so far suggests that, yes, they may be able to, although a lot more needs to be done to know this. So here is an example from, again, Joshua Grant showing that meditators have thicker cortices than controls. Again, this is done in healthy people not in patients. But if you just look at the meditators and here in this—the ACC, the anterior cingulate cortex—you see that it's much thicker in the meditators than in their match controls. And this is from our data showing that in fact yoga practitioners—again, these are not people in chronic pain, healthy yoga practitioners versus healthy control subjects—that multiple parts of the brain, lots of parts of the brain, there are no areas where the yogis have thinner, have less gray matter than the healthy controls, and lots of areas where they have more gray matter than healthy controls. As I said, despite the fact that there are all these areas that, in fact, are different in the yoga practitioners, only one area, it's only the thickness of the insula cortex that seems to be important for this increased tolerance of pain. And here, if you look at the insula, the gray matter in the insula is the only region in the brain where we see this—is that the thickness of the gray matter correlates with the individual's pain tolerance across both the yoga practitioners and the healthy controls. And if you look at just the yoga practitioners and how long they've been practicing yoga, there's a nice correlation between the size, how thick is the gray matter in the insula, and how long they've practiced yoga, suggesting that it's possible that the yoga practice itself is having a protective effect. Now this is something that Chantal will be studying here using longitudinal studies and really going into more depth to see if, in fact—these are just correlational studies—whether, in fact, yoga can alter the gray matter and how long it takes to do so if it does.

Okay. As I mentioned earlier, there is this natural age-related decline. This is looking at total gray matter across the whole brain, and you can do this in sample after sample, and you always find it. Unfortunately for us old people, as you get old, you start losing gray matter in the brain. But here's fibromyalgia patients who seem to be losing it at a much faster rate than healthy people, which I showed you in that larger dataset that I showed you earlier. On the other hand, here's total gray matter with yogis. Again, here's the—this line, which is black, is the yogis, and open circles are the healthy control match controls—and again, you're getting a decrease in this age-related decline in total gray matter compared to healthy controls. So while chronic pain seems to increase this process, some of these practices such as yoga may decrease this natural aging of the brain.