

# Unearthing cognitive powers of a 'vegetative' patient



**FM** — By Sanjeev Neelakantan

Do patients who are believed to be in an “unconscious” and vegetative state have the “ability to think”? Can doctors open a channel of communication with such physically non-responsive patients? At a time when patients in a vegetative state are considered “lost cases”, renowned British neuroscientist **Dr Adrian Owen** and his team of researchers have succeeded in giving medical science a whole new direction with the groundbreaking discovery of a means of establishing communication with such people with the help of technological apparatus. Dr Owen and his team recently “communicated” with a Canadian man who has been in a vegetative state for over a decade and learnt that he “is not in pain”. How? They used a functional magnetic resonance imaging machine (fMRI) to analyse brain activity patterns in Scott Routley, a patient who sustained a severe brain injury in a car crash 12 years ago. Dr Owen says he asked Routley to imagine that he was playing tennis if he wasn’t in pain, or imagine that he was walking around his house if he was in pain. Thinking about these movements triggered activity in different parts of the brain, which could then be measured by the fMRI in real-time. And that’s what helped Dr Owen “communicate” with Routley and understand that he was not in pain. In an interview with Future Medicine, Dr Owen talks about his research on the “consciousness” or “cognitive” potential of people in a vegetative state. Extending rehabilitative care in terms of improving cognitive responses of such patients is the long-term goal, but then we are still at the early stages of research as of today, says Dr Owen



*Dr Adrian Owen*

**What's your perception of patients in a vegetative state, considering that such cases are written off as "lost cases"?**

Well, I think every patient is different and that is the important thing. Some of them have abilities that are simply not detectable using standard clinical examination, as we have shown. For other patients, even imaging demonstrates that they are non-responsive. So I think this teaches us that we have to treat every patient as unique and do the best that we can to characterise any residual abilities that they may have.

**What helped you evolve techniques facilitating communication with such patients?**

A lot of what I do is driven by technology. This would never have been possible even a few years ago because we did not have this sort of rapid (real-time) functional magnetic resonance imaging (fMRI) that we now use routinely in these patients. I was also helped by a curiosity about consciousness and the idea that I have had for many years that some of these patients may have residual abilities that we simply don't know about.

**Tell us about the techniques, the application processes, and the success you have been able to achieve in terms of rehabilitative care for such patients.**

First, we are at very early stages and it would be wrong to assume that we have been able to add rehabilitative care for these patients. What we are able to do is to better characterise any residual cognitive abilities that they may have. We do this with techniques like fMRI and electroencephalography (EEG). We ask patients to imagine certain scenarios (like playing tennis) and we are able to detect the responses in the brain indicating that they are "command following" even if they are not physically responding at all. In future, I do hope that this will assist in efforts towards rehabilitation (for example, rehabilitation efforts could be targeted towards those cognitive functions that are shown to be intact), but we are not at that stage yet. We are only just beginning.

**When did you achieve a breakthrough in understanding the imaginative potential and brain activation of such patients, making you confident of their status of being "conscious"?**

Our paper in 2006 in the journal 'Science' was the first to establish that some of these patients (in that case, it was just one case)

are actually conscious. So, that was the moment when everything changed. In 2010, we published a paper with many more patients, showing that about one in five of them were conscious. These studies told us how frequently this (cognitive response) occurs in this population.

**How far are we from introducing rehabilitative care into mainstream clinical practices and what are the hurdles?**

As I say above, this is not a rehabilitation technique. It is a way of discovering patients who are conscious but incapable of expressing that to their carers and clinicians. As for introducing the technique more widely clinically, we are some way off that for now because it is incredibly complicated and requires significant expertise in functional neuroimaging, statistics, neuroanatomy, and other aspects of cognitive neuroscience. It also requires a certain type of scanner that is not available in every hospital. Most of these scanners are used purely for research and are not available for general clinical use.

**Tell us about the plan to make EEJEEP (a jeep equipped with experimental equipment) an international project for people in a vegetative state.**

EEG is considerably cheaper and more portable than fMRI. We have developed a system using EEG that can detect consciousness at the





bedside in some of these patients. The entire system is portable and we travel from patient to patient in the so-called EEJEEP. This is certainly a technology that I can easily imagine scaling up to be more internationally available. The EEG technology is widely available and affordable, and through my international collaborations, we are now doing this in several countries. However, it is important to realise that this is still a complicated scientific challenge involving significant expertise that is not as widely available as would be necessary for this to happen everywhere. That is to say, it will

not be available for every patient for some time.

**What are the challenges on the research front and how do you plan to take the research forward?**

I don't really have time to go into great detail about my future plans. We are concentrating on making this technology more widely available, seeing more patients, developing the EEG to allow real-time communication, and much more. You will certainly read about it in the scientific literature.

**How many patients have**

**been covered under your study so far and how promising is their cognitive response?**

We have probably seen close to 100 patients in the last five years and one in five of them (approximately) shows good signs of having residual consciousness. So, in the majority of patients, we see nothing, but in a significant minority, we do see a cognitive response.

**Is there any other research body in the world that has taken a similar initiative to help those in a vegetative state?**

Not to my knowledge. My work is funded, in part, by the McDonnell foundation in the USA. So, in a sense, they are certainly contributing to helping these patients. My main funding comes from the Canadian government through a Canada Excellence Research Chair Program, which has enabled me to reach my recent goals, and previously, I was funded in the United Kingdom by the Medical Research Council.

**What's your message to those who have challenged your theory of a patient being in a "conscious" state?**

They are wrong. We have now published numerous studies in peer reviewed scientific journals demonstrating that some (albeit rare) patients may be conscious and able to communicate information by modulating their brain activity, yet be entirely physically non-responsive at the same time. When those people who challenge this are able to show me a single UNCONSCIOUS patient who can answer questions in the scanner (such as "does your sister have a baby or not?"), then I will be happy to debate the significance of my findings with them. I have presented data to support my findings. Similarly, they need to present data to refute my findings. ■