# Scientists find way to predict who is likely to wake up during surgery

January 25 2016, by Srivas Chennu, University Of Cambridge

Measuring certain kinds of brain activity may help doctors track and predict how patients will react to anaesthesia before going under for surgery, our research has found.

Doctors currently have no perfectly reliable way of ensuring patients are adequately unconscious before an operation begins. Although rare, the uncertainty sometimes results in traumatic experiences of patients "waking up" during surgery.

Using a technique that measures electrical impulses in the brain of those in various states of sedation, we discovered network "signatures" that can indicate when loss of consciousness will occur.

Doctors can use similar techniques to accurately identify the concentration of drug needed for a patient to lose consciousness and maintain that loss throughout an operation.

## Everyone is different

Every day in Australia, more than 6,000 people are anaesthetised for surgery. Doctors need to figure out exactly how much sedative to give them, and keep them unconscious throughout the operation.

Anaesthetists estimate the concentration of sedative required using calculations mainly based on a patient's weight. As the patient "goes under", their level of awareness is monitored by observing indirect – and somewhat crude – measures, such as blood pressure, heart rate or physical movement.

This method works well in most cases, but people's susceptibility to anaesthesia varies. One to two in every 1,000 people report having some awareness or recall during surgery. This equates to 2,000 to 4,000 such cases each year in Australia.

Recollections include hearing people speaking during surgery, sensations of not being able to breathe, and experiencing pain.

Naturally, experiences such as these are emotionally traumatic. What's more, many suffer mental distress long after the surgery, resulting in negative memories of their hospital experience. Some have even reported a reduction in their quality of life.

## Losing consciousness

Figuring out the best way to sedate someone essentially comes down to understanding how the brain gains and loses consciousness; that is, the inner world of awareness, feelings and sensations. Although a challenging theme in neuroscience, rapid advances have been made in this area.

Some theories suggest that key networks of brain areas communicate with each other to integrate information processing and generate consciousness. This communication network gives off signals that indicate how conscious an individual is.

The networks come about from brain neurons firing simultaneously at a certain frequency. We can observe them by using a non-invasive technique called electroencephalogram (EEG), where sensors placed on the scalp record the neurons' electrical impulses. These recordings provide us with a brain "signature" indicative of awareness levels.

Brain monitoring such as this is not commonly used in the operating theatre today. One reason is that current devices are unable to deal with the considerable variability in how people respond to sedatives. But our study shows that devices calibrated for accurate monitoring based on the latest neuroscientific advances could help reduce the incidence of awareness during surgery.

## Our study

We have previously shown that network signals of consciousness can also be seen in some people in a vegetative state.

This gave us an indication of the types of signals that could be seen in those who experience some awareness during surgery, but are unable to communicate. But we also needed to show that a similar brain-based measure worked well in cases where we could manipulate the level of consciousness.

Our latest study, published in the journal PLOS Computational Biology, helped us better understand the transition to unconsciousness during sedation, and how this transition varies from person to person.

We gave a steadily increasing dose of a commonly used anaesthetic called propofol to 20 people. At the same time, we measured the brain networks known to be associated with consciousness using EEG. The drug was administered at different dosages, causing varying degrees of mild to moderate sedation across our participant group, rather than complete unconsciousness in all of them.

We also measured the behavioural responsiveness of the participants with a simple task. They were asked to press one button if they heard a "ping" and a different button if they heard a "pong".

Alongside this, we recorded the concentration of the drug in their blood at different times. Altogether, we got the information needed to connect the activity of their brain networks to their individual drug responses.

## The right measure

We found that the strength of a participant's brain network was clearly linked to their behavioural responsiveness. In other words, as the brain network indicating consciousness weakened, behavioural evidence of awareness also diminished.

Interestingly, while some participants showed behavioural evidence of consciousness at moderate levels of the anaesthetic, others remained responsive.

We found that it was actually the strength of their brain networks before sedation that predicted why some eventually lost consciousness while others did not. In other words, people with weaker baseline networks of consciousness were able to lose it more quickly than those with stronger baselines.

Our current findings indicate the change in consciousness due to the sedative was clearly correlated with specific patterns of brain network activity. This gives us confidence in making the "reverse inference" that tracking this network activity can be used to infer the true level of consciousness in the absence of behaviour.

Further engineering and testing could help advance and adapt current brain monitoring technology for use in the operating theatre. It is clear that networks measured by an appropriate EEG can capture and explain why people respond differently to anaesthesia.

This monitoring can help doctors optimise the amount of drug needed for someone to become unconscious without increasing risk of complications or awareness during surgery.

*This article was originally published on* The Conversation. *Read the* original article.

Source: The Conversation