

Alpha brain waves may predict post-surgery pain

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Patients who are most likely to suffer severe pain following an operation can be reliably identified using a new technique developed at the University of Birmingham.

The technique could allow clinicians to plan additional preventative pain medication during surgery for [vulnerable patients](#). This could mean patients are likely to experience less [acute pain](#) during recovery, and are also less likely to go on to suffer chronic symptoms.

In a pilot study, published in the *British Journal of Anaesthesia*, a team of researchers showed how electroencephalography (EEG) can be used to measure [brain activity](#) in patients about to undergo chest surgery, or thoracotomy.

Before surgery, the team measured the patients' alpha waves, brain signals which oscillate between 8 and 14 Hz. Then, over 72 hours following surgery, patients were asked to score their pain on a scale from 1-10. The researchers were able to demonstrate a clear link between the patient's alpha waves and their responses to pain. In particular, they found that people whose alpha waves oscillated below 9 Hz were much more vulnerable to [severe pain](#) post-surgery.

Dr. Ali Mazaheri, of the University of Birmingham's Centre for Human Brain Health and School of Psychology, is senior author of the study. He says that "the experience of being in pain is complicated and subjective, but it's clear that these alpha waves are a reliable indicator of how severely an individual will experience pain. That offers clinicians a really valuable biomarker that they can use to prevent pain becoming an issue, rather than treating it after it has taken hold and become a serious, and potentially chronic problem."

The study was carried out by Samantha Millard, in the Centre for Human Brain Health, in collaboration with researchers in the University's Institute of Inflammation and Ageing, University Hospitals Birmingham NHS Foundation Trust. It involved 16 patients about to undergo surgery to treat lung cancer.

The alpha waves measured before surgery were able to predict, with 100% accuracy, which patients would report a pain score after surgery of 7/10 or higher.

This work extends findings from a longstanding collaboration between Dr. Mazaheri and Dr. David Seminowicz (Western University, Canada), in which work led by Dr. Andrew Furman (University of Maryland Baltimore) showed PAF is a reliable predictor of pain sensitivity across multiple pain models and timescales (Furman 2018, 2019, 2020, 2021). The new study adds a crucial piece to this literature: the first validation of the pain sensitivity biomarker in a clinical population.

While more work is required to determine the precise nature of the link between alpha waves and pain, the team believe it is related to specific pathways in the brain that are known to relay sensory messages from the thalamus—the brain's central hub for sensory information. Since alpha waves are, in part, regulated by the thalamus, the team believe their frequency directly reflects the balances between pathways which signal pain and those which suppress it.

Fan Gao-Smith, Professor in Anaesthesia, Critical Care and Pain in the University of Birmingham's Institute of Inflammation and Ageing and co-author of the study, says that "the alpha waves were really specific and accurate. Using this technique we can make real advances in [pain management](#), not only in surgery, but in other treatments such as chemotherapy, enabling both clinicians and patients to make more informed choices."

Mr Babu Nadu, also in the University's Institute of Inflammation and Ageing and Queen Elizabeth Hospital, University Hospital Birmingham NHS Foundation Trust, is an academic consultant thoracic surgeon and co-author on the study. He says that "chronic pain is relatively common for patients who experience severe acute pain after surgery. Current

guidelines recommend anti-depressants and acceptance therapy for people in this position. If we limit acute pain in the period directly following [surgery](#), there is a real chance they won't go on to develop chronic symptoms."

In the study's next phase, the team hopes to test the technique in a larger patient cohort and continue studying the link between alpha waves and how the brain processes pain.

More information: Samantha K. Millard et al, Predicting postoperative pain in lung cancer patients using preoperative peak alpha frequency, *British Journal of Anaesthesia* (2022). [DOI: 10.1016/j.bja.2022.03.006](#)

Provided by University of Birmingham

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