Widely-applied painkiller weakens and fragments newborn brain activity in the short term

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This thesis, titled “Effects of fentanyl on the cortical activity of neonates” and authored by Timo Vehviläinen was conducted in the neonatal brain research center (BABA Center) in Helsinki’s Children’s Hospital.

Newborn babies that require emergency care in the NICU (Neonatal Intensive Care Unit) often need to be heavily sedated during treatment. One of the most frequently used painkillers is fentanyl, which is a potent opioid roughly 100 stronger than morphine. This study aimed to find out how fentanyl affects the brain state of newborns in the short term, to start the discussion on if and how it might affect later brain development.

The distribution of electric potential on the scalp—which is caused by electric currents in the cortex—was recorded from 16 newborn babies using electroencephalography (EEG), while they underwent a painful procedure and were treated with fentanyl. The signal periods right before and after fentanyl administration were analyzed using multiple (9) different methods, with the intent of finding variables that showed a significant reaction to fentanyl consistently across subjects.

The results indicate that fentanyl causes a general weakening of electric potential, especially in the posterior brain area and in the right hemisphere. There were also signs of de-coupling between multiple brain areas than had previously been active together in the same frequency range. All of these effects were detected approximately 3-4 minutes after fentanyl was administered.

These results could not be found using conventional means of EEG evaluation. The intensity of the detected reactions varied greatly between individuals depending on their brain state before the onset of fentanyl. The afore-mentioned effects, although eventually quite strong, were only discovered after taking these individual baseline differences into account. This suggests that such a personalized approach should also be used in the future.

The automatized and multi-faceted EEG analysis pipeline built for this study has been made freely available for use in other laboratories. It is suitable for a wide range analyses that aim to investigate short-term effects of any given stimulant.

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Two-sentence summary for social media.

Fentanyl is an opioid painkiller roughly 100 stronger than morphine, which is frequently used in emergency treatment of newborns. It was found to affect their brains by weakening general signaling and causing disassociation between brain areas, especially in the right hemisphere and posterior brain areas.