After anesthesia, “primitive” consciousness awakens first

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Courtesy of the Academy of Finland
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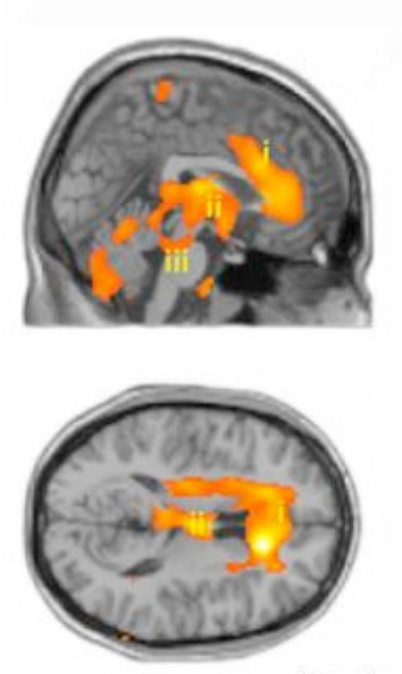
Our confused first waking moments after general anesthesia represent a rudimentary form of consciousness that arises from ancient brain structures, new research concludes.

The scientists involved described this muddled mental state as a “primitive” consciousness based on deep brain structures that humans possess in common with many animals.



PET scan findings are said to show that the emergence of consciousness after anesthesia is associated with activation of deep, ancient brain structures. The cross-sections above show this activation as red-yellow areas in the anterior cingulate cortex (i), thalamus (ii) and the brain stem (iii). (Credit: Turku PET Center)

The investigators didn’t take on the more difficult question of whether this vague awareness actually resembles animal consciousness. But they did say that studies of the anesthetized brain could shed light on how that mysterious quality, consciousness, arises in our brains and emerged in evolution.

The researchers used scans to examine volunteers’ brains as they woke from general anesthesia. Meanwhile, the experimenters who had awoken them assessed their level of awareness, based on their responses to a spoken command.

“The central, core structures of the more primitive brain structures… appeared to become functional first, suggesting that a foundational primitive conscious state must be restored before higher-order conscious activity can occur,” explained Harry Scheinin of the University of Turku in Finland, who led the study.

The brain areas involved in these fuzzy early stages of awareness are known as the brain stem, thalamus, hypothalamus and the anterior cingulate cortex, he explained. This excludes the outer region of the brain, called the cortex, which is a relatively recent evolutionary development most fully developed in humans.

Twenty-two young, healthy volunteers went under anesthesia for the study using either of two powerful anesthetics, dexme-detomidine or propofol. The first is used as a sedative in intensive care; its effect is thought to closely resemble normal sleep, as it can be reversed with mild stimulation or loud voices at normal doses. Propofol is widely used for general anesthesia, and is also the substance that—improperly used as an all-around sleep aid—was allegedly connected to pop singer Michael Jackson’s death.

Despite differences between the drugs, the brain processes seen in the waking volunteers were similar in both cases, said the investigators, who reported their findings in the April 4 issue of *The Journal of Neuroscience*. As full awareness bloomed, the “primitive” brain areas became linked through electrical nerve activity with more advanced areas called the frontal and inferior parietal cortex. The type of brain scanning used was positron emission tomography, which employs radiation, or nuclear medicine imaging, to produce three-dimensional, color images of processes within the body.

Showing which brain mechanisms are involved in the emergence of the conscious state is an important step forward in the scientific explanation of consciousness, according to the researchers. Yet much harder questions remain, they stressed: how and why these neural mechanisms create the subjective feeling of being, the awareness of self and environment, that characterize consciousness.