Letter to the Editor

Oblivion Orchestra Hall: How to Facilitate Emergence from Anesthesia with Music

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Respected Editor

One of the most challenging issues in anesthesia is reducing the time the patient stays in the recovery room. The time to emerge from anesthesia is affected by several factors, such as patients' general conditions, anesthetic factors, duration of surgery, and other stimuli (1). Among these, the type of anesthetic used and the extent of the procedure performed are the main factors in determining the duration of anesthesia. However, reducing this period beyond all of the above can provide the conditions for reducing the risks of anesthesia and the costs involved.

Anesthesia, in many ways, is similar to sleeping (2). Electroencephalographic features and brain regions are activated in both states of unconsciousness (3). Thus, sleep-related pathways can play an effective role in resolving the problems caused by prolonged anesthesia.

Using sounds is a common way around the world to wake people up. Understanding how the brain translates a structured sequence of sounds into a pleasant experience is a question that may be crucial to understand the processing of abstract rewards better. Previous findings point to the dopaminergic system in music-evoked pleasure.

Dopamine is a neurotransmitter synthesized and released by neurons in the ventral tegmental area and substantia nigra pars compacta of the mesencephalon (4). Mesencephalic dopamine neurons are leading to important insights and treatments for schizophrenia, Parkinson's disease, attention-deficit hyperactivity disorder, and other conditions (5). However, the role of dopamine in promoting wakefulness has been relatively precited. Recently, interest in this area has been rekindled by newer data demonstrating that dopamine plays an important role in sleep/wake modulation and by advances in neuroscience that allow for selective activation and inhibition of neural circuits with optogenetics and chemo -genetics.

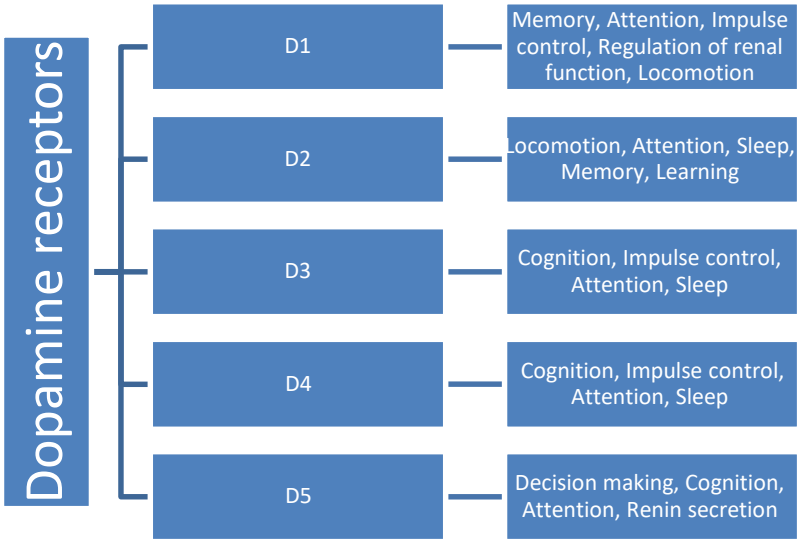

Figure 1. The five subtypes of dopamine receptors

Mesencephalic dopamine neurons have reciprocal afferent and efferent connections to many subcortical arousals promoting pathways. These interconnections between the ventral tegmental area and substantia nigra pars compacta dopamine neurons and known arousal-promoting nuclei suggest that dopamine promotes wakefulness (6). In addition, there is a population of dopamine neurons in the ventral periaqueductal gray that increases the expression of c-Fos during the awake state (7).

There are five subtypes of dopamine receptors (D1–D5) (Fig.1) (8). The D1 receptor is the most abundantly expressed in the brain and appears to be chiefly involved in the arousal-promoting actions of dopamine. This receptor couple to G stimulatory sites and activate adenylyl cyclase. This activation leads to the production of the cAMP and finally leads to the production of PKA, which causes more transcription. Studies in rats found that a D1 agonist was efficacious for inducing emergence from isoflurane anesthesia. Hence it can be said that D1 receptors are chiefly responsible for the arousal-promoting actions of dopamine that induce emergence from general anesthesia (9).

Electrical deep brain stimulation of the ventral tegmental area induces emergence from isoflurane and propofol anesthesia in rats. A study found that dopamine released by ventral tegmental area neurons is sufficient to induce the transition from the unconscious, anesthetized state to the awake state. Optogenetic activation of ventral tegmental area dopamine neurons was also reported to increase wakefulness and decrease sleep in mice. In particular, selective terminal stimulation of ventral tegmental area dopamine neurons that project to the nucleus acumens produced the most robust increase in wakefulness, suggesting that the mesolimbic pathway is particularly important for maintaining arousal (10).

Use of 6-hydroxydopamine to ablate dopamine neurons bilateral ventral tegmental area lesions delay emergence from propofol anesthesia. However, anesthetic sensitivity to isoflurane and ketamine was not affected by these lesions. Propofol has been shown to reduce dopamine levels in the prefrontal cortex (11). Thus, it can be said that dopaminergic neurons in the ventral tegmental area and a ventral periaqueductal gray area contribute significantly to emergence from propofol anesthesia and that inhibition of dopaminergic neurotransmission may play a particularly important role in the hypnotic actions of propofol (12). All of this suggests that dopaminergic pathway stimulation may be one of the best ways to reduce or manage the duration of anesthesia.

However, stimulation of the auditory sense, as the first returning sense after general anesthesia, can stimulate dopaminergic pathways. Therefore, it seems that the design and implementation of clinical studies based on patients hearing stimulation by creating acoustic sounds can be considered a study idea in anesthesia and postoperative care.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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