Sleep and Anesthesia: Two Different Analogous

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"In its simplest and most positive terms, sleep is a desired state of unconsciousness" (1). Anesthesia in the contrary is another type of "desired unconsciousness". However, they are actually like the two unequal twins sharing some features but different in others. Sleep and anesthesia are different in several aspects making them unique neurophysiologic states with complex mechanisms of action (2). Here, we aimed to compare these two states concisely, that may be a source of more interesting scientific pearls for whom working in this field especially sleep medicine specialists.

Modulation of brainstem autonomic function is seen in both sleep and anesthesia. Differences of these two states of sleep and anesthesia are summarized in a concise and coherent pattern in table 1. Sleep state constitutes of different frequencies and types of activation; however, electroencephalography (EEG) pattern in anesthesia has a uniform picture. Furthermore, some similarities exist between slow-wave sleep and anesthesia-induced unconsciousness. Sleep-wake state has a homeostatic regulation with an internal inserted clock named circadian system with a stage wise structure [Wake, Non-Rapid Eye Movement (Non-REM) Stages N1, N2, N3, and REM] (Figure 1).

Such structure and internal modulation with a spontaneous generation and termination has not described for the anesthetic state, yet. Figure 1 illustrates the differences of the two states according to EEG.

Reports have demonstrated fundamental difference between the onset of anesthesia and wakefulness-sleep transition (9-13).

Table 1. Comparison between characteristics of sleep and anesthesia

Characteristic	Sleep	Anesthesia
Mediated by activation of VLPO and inhibition of TMN (3)*	Yes	Yes
Spontaneous generation and termination	Yes	No
Reversibility by noxious stimuli	Yes	No
Arousal capability	With sufficient stimulation	At least with some drug elimination
Homeostatic regulation	Yes	No
Stage-wise structure	Yes	No
EEG pattern	Different frequencies and types of activation	Uniform EEG picture
Transient stage between fully awake and complete unresponsive state (11-13)	No (sharp α–θ EEG transition from wakefulness to sleep)	Yes

*Several contradictions exist:
Rats and mice with complete lesions of the VLPO can still be anesthetized.
Lesions of VLPO lead to a transient resistance to volatile anesthetics, if some time elapses following a VLPO lesion, the animals show increased sensitivity to isoflurane anesthesia attributable to increased homeostatic sleep drive.
Direct inhibition of the TMN produces sedation but not anesthesia.
Animals without VLPO neurons have profound insomnia (4-10).
VLPO: Ventral preoptic area; TMN: Tuberomammillary nucleus; EEG: Electroencephalography

Further investigations are warranted to explore the unique characteristics of anesthesia and sleep in comparison with each other. The findings would elucidate more details of sleep structure and neurophysiology.

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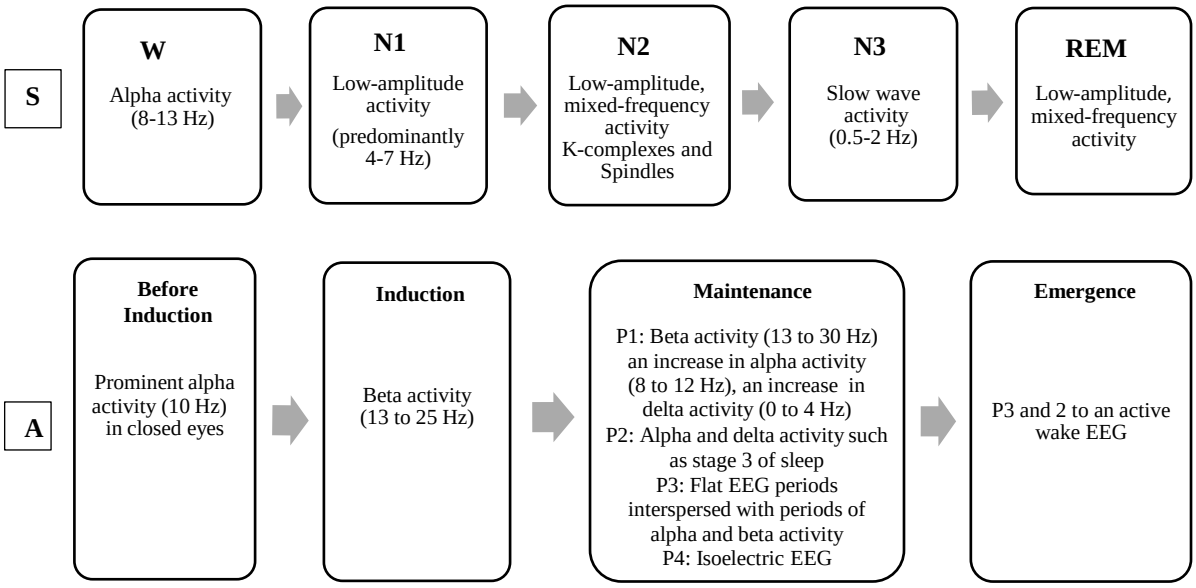

Figure 1. Electroencephalography (EEG) in different sleep stages (N1, N2, N3, REM) and anesthesia periods (Induction of anesthesia, Maintenance of anesthesia, and Emergence from anesthesia)
EEG: Electroencephalography; S: Sleep; A: Anesthesia; W: Wake Stage; N1: Stage 1; N2: Stage 2; N3: Stage 3; REM: Rapid Eye Movement; P: Phase (1, 9)

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