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Medical Imaging for Understanding Sleep Regulation KENNETH WONG, Virginia Tech

Sleep is essential for the health of the nervous system. Lack of sleep has a profound negative effect on cognitive ability and task performance. During sustained military operations, soldiers often suffer from decreased quality and quantity of sleep, increasing their susceptibility to neurological problems and limiting their ability to perform the challenging mental tasks that their missions require. In the civilian sector, inadequate sleep and overt sleep pathology are becoming more common, with many detrimental impacts. There is a strong need for new, in vivo studies of human brains during sleep, particularly the initial descent from wakefulness. Our research team is investigating sleep using a combination of magnetic resonance imaging (MRI), positron emission tomography (PET), and electroencephalography (EEG). High resolution MRI combined with PET enables localization of biochemical processes (e.g., metabolism) to anatomical structures. MRI methods can also be used to examine functional connectivity among brain regions. Neural networks are dynamically reordered during different sleep stages, reflecting the disconnect with the waking world and the essential yet unconscious brain activity that occurs during sleep.

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