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Characteristics of sleep-active neurons in the medullary parafacial zone in rats

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Abstract

Growing evidence supports a role for the medullary parafacial zone in non-rapid eye movement (non-REM) sleep regulation. Cell-body specific lesions of the parafacial zone or disruption of its GABAergic/glycinergic transmission causes suppression of non-REM sleep, whereas, targeted activation of parafacial GABAergic/glycinergic neurons reduce sleep latency and increase non-REM sleep amount, bout duration, and cortical electroencephalogram (EEG) slow-wave activity. Parafacial GABAergic/glycinergic neurons also express sleep-associated c-fos immunoreactivity. Currently, it is not clear if parafacial neurons are non-REM sleep-active and/or REM sleep-active or play a role in the initiation or maintenance of non-REM sleep. We recorded extracellular discharge activity of parafacial neurons across the spontaneous sleep-waking cycle using microwire technique in freely behaving rats. Waking-, non-REM sleep-, and REM sleep-active neuronal groups were segregated by the ratios of their discharge rate changes during non-REM and REM sleep versus waking and non-REM sleep versus REM sleep. Parafacial neurons exhibited heterogeneity in sleep-waking discharge patterns, but 34 of 86 (40%) recorded neurons exhibited increased discharge rate during non-REM sleep compared to waking. These neurons also exhibited increased discharge prior to non-REM sleep onset, similar to median preoptic nucleus (MnPO) and ventrolateral preoptic area (VLPO) sleep-active neurons. However, unlike MnPO and VLPO sleep-active neurons, parafacial neurons were weakly-moderately sleep-active and exhibited a stable rather than decreasing discharge across sustained non-REM sleep episode. We show for the first time that the medullary parafacial zone contains non-REM sleep-active neurons. These neurons are likely functionally important brainstem compliments to the preoptic-hypothalamic sleep-promoting neuronal networks that underlie sleep onset and maintenance.

parafacial zone, median preoptic nucleus, ventrolateral preoptic area, extracellular recording, sleep-active neurons

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