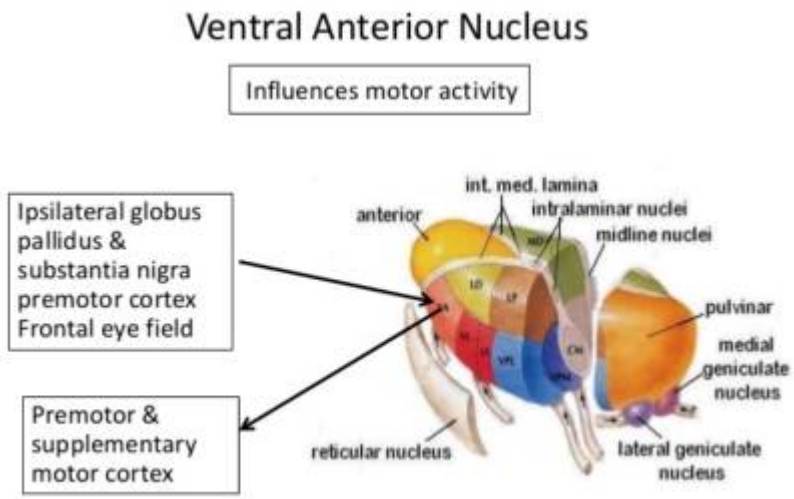
Anterior thalamic nucleus



They are considered to be part of the limbic system.

The anterior nuclei of thalamus (or anterior nuclear group) are a collection of nuclei at the rostral end of the dorsal thalamus.

They receive afferents from the mammillary body via the mammillothalamic tract and from the subiculum via the fornix. In turn, they project to the cingulate gyrus.

These nuclei are thought to play a role in the modulation of alertness and are involved in learning and episodic memory. They are considered to be part of the limbic system.

The anterior nucleus of the thalamus forms an integral part of the Papez's circuit and has been implicated in the memory pathway. The input to this nucleus is mainly from the hippocampus and entorhinal cortex via the fornix and the mammillary body. AN in turn projects to a variety of cortical regions including cingulate gyrus, posterior parietal/insular region, and lateral temporal cortex. The role of this pathway in initiation and propagation of seizures has been extensively studied.

A pilot study of Pizarro et al., from the University of Alabama at Birmingham, United States demonstrates that seizures in mesial temporal lobe epilepsy and temporal-plus epilepsies (i.e., temporoperisylvian) can be detected reliably in the anterior thalamic nucleus (ATN). Further studies are needed to validate these findings [1].

Previous imaging studies independently highlighted the role of the anterior thalamus (ANT) and nucleus accumbens (NAcc) in successful memory retrieval. While these findings accord with theoretical models, the precise temporal, oscillatory and network dynamics as well as the interplay between the NAcc and ANT in successfully retrieving information from long-term memory are largely unknown.

The University of Hamburg, Lübeck and Magdeburg in Germany addressed this issue by recording

intracranial electroencephalography in human epilepsy patients from the NAcc (n = 5) and ANT (n = 4) during an old/new recognition test.

The findings demonstrate that differences in event-related potentials between correctly classified old (i.e., studied) and new (i.e., unstudied) images emerged in the NAcc and ANT already between 200 and 600 ms after stimulus onset. Moreover, time-frequency analyses revealed theta (4-8 Hz) power decreases for old compared to new items in the NAcc and the opposite effect in the ANT. Importantly, Granger causality analyses revealed a directional communication from ANT to NAcc suggesting that entrainment from ANT drives successful memory retrieval.

Together, this findings show evidence for the notion that the NAcc and ANT receive memory signals, and that theta oscillations may serve as a mechanism to bind these distributed neural assemblies [2)].

Mirski et al., first reported their results of mammillothalamic tract lesioning in seizures induced by pentylenetetrazole (PTZ) in guinea pigs [3)].

Lesioning the mammillothalamic tract resulted in significant protection against both electrographic and clinical seizures, whereas lesioning of the surrounding nuclei (due to higher current settings) was not beneficial. In a follow-up study, the authors studied the effect of Electrostimulation of the mamillary nuclei in rat model of PTZ-induced seizures [4)].

The high-frequency (100 Hz) stimulation but not low-frequency (8 Hz) stimulation resulted in protection from PTZ-induced clonic seizures but failed to abolish the electrographical cortical response associated with PTZ administration. Their group further refined the stimulation target to AN and reported significant protection from PTZ-induced clonic seizure threshold as well as cortical response associated with it [5)]

Several anatomical characteristics make AN a powerful target for stimulation [6) 7)]

This nucleus receives afferents from the hippocampus and the mesial temporal region, which are known to be highly epileptogenic. The other major afferent to AN is derived from bipolar projections from mamillary body, the other projection being the midbrain [8)]. The AN projects diffusely to the cortex, especially the cingulate cortex, insula, and medial temporal lobe. Finally, the inhibitory influence by the reticular nuclei on the thalamocortical circuitry in the AN-cortical projections is rather scarce compared with that present in other thalamic nuclei.

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see Anterior Thalamic Nucleus Deep Brain Stimulation.

1)
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2)
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[5], [7], [8]
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