

Acetylcholine (ACh) is a neurotransmitter that has multiple pathways in the central and peripheral nervous systems, and plays a role in many bodily functions:

- **Motor control:** ACh is the main neurotransmitter in the peripheral nervous system that controls motor pathways.
- **Cognitive functions:** ACh pathways in the basal forebrain project to the hippocampus, amygdala, and frontal lobes, and are involved in memory encoding, fear reactions, and other cognitive functions.
- **Autonomic nervous system:** ACh is a major neurotransmitter in the autonomic nervous system, which controls many automatic bodily functions, such as the proper functioning of internal organs.
- **Immune system:** ACh is secreted by T lymphocytes.
- **Other functions:** ACh affects the gastrointestinal, respiratory, urinary, and exocrine systems, as well as the eye and male reproductive system.

The **synthesis of acetylcholine (ACh)** in the nervous system involves several steps, including:

- **Choline and acetyl coenzyme A (acetyl CoA) precursors:** Choline is derived from dietary sources and acetyl CoA is synthesized in mitochondria.
- **Choline acetyltransferase (ChAT) enzyme:** Choline and acetyl CoA are combined by the enzyme ChAT to produce ACh. The activity of ChAT is the rate-limiting step in the process.
- **Vesicular acetylcholine transporter (VACHT):** ACh is packaged into vesicles for storage in the terminal by the VACHT.
- **Choline reuptake:** After ACh is released at the synapse, choline is reabsorbed by neurons through high-affinity plasma-membrane choline transporters (CHTs).
- **Acetylcholinesterase (AChE):** AChE breaks down ACh into choline and acetate, which is essential for muscle function.

