Relationship between amygdala and mental disorders

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Mental disorders are a group of diseases with changes in cognition, emotion, behavior, and other aspects, which may be accompanied by painful experience or functional impairment. The cognition, emotion, and behavior change make patients feel pain, impaired, or increase the risk of death, disability, etc. The dysfunction and over-activation of the amygdala and its circuits make it always highly sensitive and reactive to threatening stimuli, which is often thought to be related to the pathogenesis of mental disorders.

The amygdala is located in the anterior part of the inferior horn of the lateral cerebral ventricle and the ventral part of the lentiform nucleus and consists of different neuronal groups. In the previous neuroimaging studies in brain, the amygdala is a single structure. Now, it has been found that the amygdala is a structurally and functionally heterogeneous nucleus composed of multiple subregions.

On the structure, the Amy main points by the basolateral amygdala (BLA) and central amygdala (CeA), they are the main input and output nuclei. Among them, the BLA including lateral nucleus (LA), basal hominins amygdala (BA) and inside of the basomedial amygdala (BMA). CeA included lateral central amygdala (CeL) and medial central amygdala (CeM).

Due to its relatively complex structure, the amygdala has a variety of functions. The amygdala is connected with the hippocampus and basal ganglia, which can participate in various functions of the body, neuroregulation, and hormone secretion. In addition, the stria terminalis is connected with the septa area and hypothalamus to participate in the generation and expression of human emotions, which plays a key role in neural and endocrine regulation, cognition and memory, and emotional regulation (Figure 1) [1].

Figure 1 Introduction to the functions of the amygdala

The central amygdala sends most of its efferent projections to many different cortical and subcortical areas that directly regulate autonomic responses and context-dependent behaviors: Autonomic nervous system, reflexes, and hormone secretion [2]. Corticotropin-releasing hormone is the main driving force of the hypothalamic-pituitary-adrenal axis, causing the activation of presympathetic neurons, and its abnormal secretion can lead to sympathetic disorders. Neurons in the basal amygdala secrete a variety of peptides, including corticotropin-releasing hormone, enkephalin, and neurotensin. It also expresses dopaminergic and 5-hydroxytryptamine receptors, which can be used to regulate the function of the body's adrenal cortex and the activity of neurons in the central system, and participate in the regulation of mental disorders caused by neuroendocrine abnormalities.

The three subregions of basolateral amygdala, CeL, CeM, and BA, are involved in the social perception, social connection, and social disgust network templates respectively [3]. Studies have found that changes in amygdala function are related to gender factors in social networks [4]. Changes in the function of the CeM and BA are related to the symptoms of major depression, and the CeM is related to complex social behaviors such as anxiety, reward, and fear [5–6]. These social dysfunctions may hinder the professional and social reintegration of patients with mental disorders, and have adverse effects on the prognosis of the disease [7].

The amygdala is an important target for neuro-feedback of positive emotions, and its dysfunction may be related to abnormal emotional processing in patients with mental disorders [8]. Studies have shown that, the amygdala of the brain in patients with mental disorders is structurally and significantly reduced, but no abnormal changes in morphology [9]. In alba, the tractography anisotropy scores of the amygdala connecting the prefrontal lobe (medial prefrontal cortex and orbitofrontal cortex) decreased significantly. The fMRI study found that the functional connectivity between amygdala and orbitofrontal lobe decreased significantly. The experiment of Young et al. showed that upregulation of amygdala activity can significantly improve the clinical symptoms of depression and improve the emotional processing bias [10].

The amygdala is a key structure mediating emotional processing, which is not only involved in producing positive emotional engagement, but also in regulating negative emotions such as disgust.

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https://doi.org/10.53388/PSMR2023019
stimulation and fear [11]. The amygdala is an important brain region for the regulation of negative emotions such as fear and anxiety [12]. By against the excitatory neurons, lots of GABA are inhibitory neurons in the amygdala to participate in the regulation of anxiety [13]. Studies have found that by directly or indirectly regulating anxiety-related areas, Hcr-2 receptors in the BLA can inhibit anxiety-like behaviors by γ-aminobutyric acid (GABA) neurons expressing calcium-binding protein [14]. The study found that the CeA neural circuits for generating the fear and fear memory formation have a two-way regulation effect, which can control the excessive expression of fear [15]. It can provide treatment ideas for mental disorders that occur due to fear.

Therefore, paying attention to the emotional target mechanism of the amygdala has clinical guiding value for regulating the emotional processing function of patients with mental disorders, inducing positive emotions, and interfering with negative emotions.

The amygdala is an important part of the emotional processing brain circuit in the human brain, which has a great impact on emotional activity and behavior [16]. It plays an indispensable role in neural and endocrine regulation, cognition and memory, and emotional regulation. Exploring the relationship between the amygdala and mental disorders is of great significance for the regulation and treatment of mental disorders. The close relationship between the amygdala and mental disorders needs to be further explored. In-depth exploration of the neurobiological correlation between the amygdala and its subregions and the pathogenesis of various mental disorders may help to reshape treatment strategies and optimize the prevention and treatment, programs for a variety of mental disorders.

References


Competing interests

The authors declare no conflicts of interest.

Abbreviations

BLA: basolateral amygdala; CeA: central amygdala; CeM: medial central amygdala.

Citation


Executive editor: Jing Yi Wang.
Received: 18 December 2023, Accepted: 22 December 2023, Available online: 22 December 2023.
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