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Mini Review

A Short Glance at the Role of Olfaction in Depression

Abstract

Depression as one kind of neuropsychiatric disorder affects tons of population in the world and exerts great economic and social burden. Great efforts have been made during the past decades aiming to decipher the underlying mechanism of this mental disease. Different kinds of mechanisms underlie depression, among which malfunctions in the olfactory system is one important reason. The occurrence of depression has a close association with dysfunctions in the olfactory system, which is highlighted by some brain regions responsible for depression overlapping with areas playing crucial roles in olfaction. The close relationship between olfactory malfunctions and depression is also underscored by the evidence that some patients with depression exhibited a higher probability of odor identification impairment and a reduced olfactory sensitivity as well as smaller olfactory bulb volumes. For reasons of concise and clarity, in the current review we only briefly summarized some key recent studies pertaining to the relationship between the dysfunctional olfaction and depression, to underscore potentially crucial roles of the normal olfactory system function in ameliorating the probability of the occurrence of depression.

Introduction

Depression as one kind of neuropsychiatric disorder is considered as one of the leading causes of disability [1-3], and makes great economy and society burden worldwide [4]. Great efforts have been made during the past decades with an aim to decipher the underlying mechanism of this mental disease [5-11]. The occurrence of depression was usually accompanied with several changes in the prefrontal limbic areas which mainly involved the orbitofrontal cortex, insula, anterior and posterior cingulate cortex, hippocampus, amygdala and thalamus [12, 13]. Some of these brain regions overlap with areas playing crucial roles in olfaction, suggesting olfaction is involved in emotional processing. The potential association between the olfaction and depression was firstly documented in the rodent model, where the bilaterally destroy of the olfactory bulb led to great alteration in the concentrations of dopamine and serotonin [14] and, in the end, resulting in depressive-like phenotypes [15]. Mounting evidence confirmed that a close relationship existed between the dysfunctions in olfactory system and the occurrence of depression [16-24]. For reasons of clarity and brevity, the current review only summarized some key recent studies pertaining to the relationship between the dysfunctional olfaction and depression, to highlight potentially crucial roles of the normal olfactory system function in ameliorating the probability of the occurrence of depression.

Olfaction dysfunctions are generally accompanied with depression, which is characterized by the fact that patients with olfactory loss are more likely to show depressive-like symptoms [25-27]. In other words, olfaction could be considered as a marker for depression in humans [18,19]. A relationship between the a decreased healthy neuronal density of the habenula and depressive phenotypes was demonstrated in a rat model with olfactory bulbecotomy, suggesting that olfactory dysfunctions could probably cause depression by affecting neuronal degeneration in habenular nuclei [16]. In fact, profound modifications were exhibited in various brain areas by the olfactory bulbectomy, which was probably resulted from the abnormal connections between the olfactory bulb and other brain regions, mainly the olfactory-limbic circuitry [15]. It was also confirmed that patients with depression exhibited a higher probability of odor identification impairment [17] and a reduced olfactory sensitivity as well as smaller olfactory bulb volumes [22,28,29]. These olfactory deficits in patients with depression could be caused by dysfunctions of the olfactory

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system at different developmental stages [22,28-31]. In a study selectively focused on depressed women showed that these patients exhibited decreased olfactory discrimination and reduced activation in secondary olfactory structures, which could be improved remarkably after the antidepressant therapy [18]. While some of the olfactory dysfunctions could be normalized with clinical treatment on depression [19], the structural changes in the olfactory bulb could not be improved [21], which suggests that depression may lead to some potential non-reversible modifications on the olfactory system.

Nowadays the olfaction has been considered as a therapeutic approach to depression, and olfactory stimulation could potentially improve depression [19]. It was demonstrated that olfactory training could increase olfactory function in patients with olfactory loss [32] and was helpful in the improvement of olfactory function in patients with postinfectious olfactory loss [33]. A recent study showed that olfactory training could significantly improve the depressive symptoms in patients [34], suggesting the potentially important role of olfactory training as an inexpensive and simple approach in improving the quality of life of depressive patients. Moreover, one historic study confirmed that the doses of antidepressants necessary for the treatment of depression was remarkably reduced when citrus fragrance was used to stimulate the olfactory system of depressive patients [35]. Collectively, these evidence further underscores the close relationship between the olfactory system and depression, as well as indicates the potential efficiency of olfactory training in the therapy of depression.

The relation between olfaction and depression was actually reciprocal. It was reported that about one-fourth to one-third of patients who lost their sense of smell showed depressive symptoms [36]. Though the closely reciprocal associations between the olfaction and depression, the underlying neural mechanism still remains much to be known. Olfactory dysfunctions could lead to several changes in brain functioning. Evidence documented that decreased input from the olfactory bulb affected neurotransmitter concentration and potentially modified functioning in limbic and reward related brain areas [19]. It is prosperous to perform much more studies to further unveil the underlying neural mechanisms concerning the role of olfaction in depression.

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