



## Limbic System Associated with Anxiety (Focus on Emotions Including Anxiety)

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### Abstract

The cerebral cortex can be functionally subdivided into primary sensory-motor, unimodal association, heteromodal association, paralimbic and limbic regions. Broca was the first who described limbic lobe in 1874, as a ring of gray matter, lying between the diencephalon and more lateral neocortex on the medial surface of the hemispheres. It locates outside of the corpus callosum and consists of subcallosal, cingulate and parahippocampal gyri. Septal area is also noted as a part of limbic lobe by some authors (Barr's anatomy). Actually, Thomas Willis had pictured this region and referred it as the limbus in 1664. Limbic system includes limbic lobe, amygdala, hippocampal formation (subiculum, Ammon's horn or hippocampus, indisium griseum or supracallosal gyrus, septal area), hypothalamus, anterior thalamus, parts of corpus callosum, certain nuclei of the midbrain, habenula and bundles interconnecting them (Fornix, mamillothalamic bundle or Vicq d' Azyr, Papez circuit, stria terminalis, stria medullaris, diagonal band of Broca, medial forebrain bundle). Paralimbic regions consist of orbitofrontal cortex, insula, temporal pole, parahippocampal, subiculum and cingulate gyrus. These regions, that demonstrate a transition from six-layered neocortex to a more primitive allocortex (hippocampus and dentate gyri) is called mesocortex or transitional cortex. Mesocortex receive emotional, cognitive and visceral inputs, resulting in further cortical processing. Lesions involving limbic system present with protean clinical features including emotional disturbances. Emotion can be defined as any complex feeling (e.g., fear, anger, excitement, love, hate, panic, anxiety, agitation, tension, ambivalence, apathy, abreaction, guilt, shame, impulse, ineffability, acathesia and decathesia) associated sometimes with psychic, somatic (visceral and autonomic) and behavioral components. There may be also intellectual disturbances in patients with severe emotional upsets (e.g., disorganized rational thought and unmodulated automatic behaviors). Emotion is related to affect and mood. Affect is observed expression of emotion whereas mood is pervasive and sustained emotion subjectively experienced and reported by a patient and observed by others (depression, elation and anger). In general, limbic system contributes to the preservation of the individual and the continuation of species. Its basic functions include feeding behavior, fight-to-flight response, aggression and of the emotion and of the autonomic, behavioral and endocrine aspects of the sexual response. Hippocampus contains "place cells" that encode spacial memory, thus plays crucial roles in special problem solving. Although, Jaspers has categorized feelings according to the object of emotion (fear of snake, patriotism, servile submission), their source (vital feeling, sadness, Joy) and its biological purpose, duration and intensity, but neurologists tend to classify emotion in the six following categories: 1) disturbances due to perception (illusions, hallucinations) or cognitive derangements (delusions), 2) disinhibition of emotional expression such as emotional lability and pathologic laughing/crying status, 3) rage reactions and aggressivity, 4) apathy and placidity, 5) altered sexuality and 6) endogenous fear, anxiety, depression and euphoria. In this lecture we will focus mainly on the different presentations of disturbed limbic system and their related lesion localization.

**Key words:** Limbic System, Emotions, Anxiety.

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