

Neuroimaging Role in Mental Illnesses

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Abstract

The role of neuroimaging in diagnosing, evaluating, and staging mental illnesses is underestimated globally. Most of the Psychiatrists do not even know that neuroimaging can be used to help them. If there is any neurological issue, the Psychiatrist will refer their patient to a Neurologist and the Neurologist can request any neuroimaging scan, but the Psychiatrist will not even think about using medical imaging for their patients. This misunderstanding is caused by majority of medical associations and societies who have made negative statements about using of medical imaging in mental illnesses. Until the day of publishing of this paper, all medical associations do not endorse using of medical imaging in evaluating mental illnesses as what will be mentioned later in this paper. The aim of this paper is to present astonishing scientific facts that prove the usefulness of medical imaging in diagnosing mental illnesses.

Keywords: neuroimaging; mental illnesses; psychiatry; psychology; psych radiology

Introduction

Here are three famous stories that were published in different newspapers worldwide that support this paper argument. In 1992, a 65-year-old man named Herbert Weinstein strangled his wife. Due to presence of a cyst in his brain, Weinstein's Lawyer argued his mental functions and ability to differentiate between right and wrong because of the cyst that was compressing his brain and the court reduced the charge from a murder to a manslaughter [1].

In 2000, an American male acquired paedophilic behaviours. He was a school teacher in his 40s and he started collecting child pornography. He started making sexual harassment to his stepdaughter. The police arrested him and charged him with child molestation. Inside prison, he started experiencing severe headaches and he was taken to the hospital for a check. An MRI scan revealed a tumour in the right orbitofrontal cortex which is responsible for social behaviours and decision making. In the hospital, they removed the tumour and the patient did not have any paedophilic interests. After one year, the man start having paedophilic sexual desire again and another MRI was done which revealed a new growth back of the tumour [2].

In 2009, the famous Indian case of integration with a suspected wife who killed her husband which was done on EEG and it was the first case to use an EEG to convict a suspect. This EEG technique called brain electrical oscillation signature profile which can detect the criminals. By using an EEG which shows a specific brain wave pattern called P300 during integration. Using of medical imaging in forensic science to analysis the psychology of the suspects' is a new trend now. An American company made an fMRI-based-lie-detector which can have too many psychological and psychiatric applications. These techniques can be used for forensic

psychology with serial killers and psychopaths. As well, these techniques raise too many questions about human memory privacy [3].

Neuroimaging and Psychiatry

Many psychiatric theories over the years, have been tested and proven to be inaccurate like; the extraction of all teeth to heal madness "surgical bacteriology" [4] or the masturbation theory of insanity in the 18th century which connect masturbation with mental illnesses which has been tested and showed no relation [5]. The chemical imbalance theory which connect low levels of serotonin to depression and high levels of dopamine to schizophrenia (hallucinations, paranoid, and voices). The depression is treated with antidepressants to increase the level of serotonin on the synaptic level and the schizophrenia is treated with antipsychotics which reduced the level of dopamine in presynaptic neurons or some neurons have high density of dopamine receptors. Serotonin metabolizing to become 5-hydroxyindole acetic acid (5-HIAA) while dopamine becomes a homovanillic acid (HVA) which can detect their levels in cerebrospinal fluid (CSF). This theory have been tested and there are many claims that the chemical imbalance theory is a wishful thinking [6]. This theory was introduced and supported, so that pharmaceutical companies can sale more medications with no scientific evidence that prove and support the chemical imbalance theory in the brain [6].

Similar to all the previous mentioned psychiatric theories, the idea of using medical imaging to diagnose mental illnesses has been criticized heavily. One example is Daniel Amen the director of Amen Clinics where he uses SPECT scan to evaluate mental illnesses to compare the activity in healthy individual to ill patients [7]. Amen criticized by the Society of Nuclear Medicine and Molecular Imaging (SNMMI) by stating that SPECT has no value in diagnosing psychological disorders [8]. The

American Psychiatric Association (APA) claimed “there is no sufficient evidence for the usefulness of neuroimaging in psychiatry” which is responsible for making all Psychiatrists avoid using medical imaging with mentally ill patients to diagnose these illnesses [8]. Other researchers like Martha Farah and Seth Gillihan, condemned Amen’s approach in employing medical imaging in diagnosing psychiatric illnesses [9, 10]. In addition, they claimed that he is exposing his patients to radiation and he is making financial profit of unproved science which is ethical issues associated with Amen’s work. Irving Kirsch as well, condemned Amen’s work and he asked to publish the scientific benefits of using a SPECT scan for mentally ill patients in a peer-reviewed journal [11]. Anjan Chatterjee published a paper about one of Amen’s cases discussing how Amen broke the standards of care [12]. Amen claim that SPECT does not only show blood’s flow instead it shows the brain’s function [13]. Amen prefers SPECT due to it’s availability in many hospitals [13]. In addition, he claimed that researchers are biased to PET scanners [13], while SPECT is better which is not accurate scientifically as it’s well known that SPECT gives poor contrast and spatial resolution compared to PET scan. On the other hand, SPECT is generally known to be cheap and widely used due to the long half-lives tracers (6 hours) which allow more imaging time, while PET tracers have half-lives (75 seconds).

Amen had published a book titled “images of human behavior” showing the different patterns in different mental disorders like post-traumatic stress disorder (PTSD), road rage, obsessive-compulsive disorder (OCD), attention deficit hyperactivity disorder (ADHD) and a long list of mental disorders [13]. As well, Amen did many press interviews, one segment with Dr. Oz to explain the usefulness of SPECT scan in mental illnesses, TED talks, and he published many information on his website. Some of Amen’s papers are not published in a peer review journals with a high impact factors. Amen was in charge of the National Football League Kicker Tom Dempsey’s case, where Amen found 3 holes in the frontal lobes of Dempsey’s brain. In 2012, Tom was diagnosed with dementia [14]. After all the denying from the Society of Nuclear Medicine & Molecular Imaging and the APA, the Neuroscientist James Fallon found a SPECT pattern in psychopaths (i.e. serial killers) [7]. The prefrontal cortex is damaged in psychopath which makes them show a lack of empathy [15]. Both areas (i.e. orbital cortex and anterior temporal cortex), are damaged. As well, Fallon found a genetic pattern in serial killers (all they have the MAO-A gene which makes the person violent and aggressive) which support the SPECT findings in psychopaths [15]. Fallon’s findings support the usefulness of SPECT and medical imaging in mental disorder [15].

Dopaminergic Pathways

There are three major dopaminergic pathways that started from two points; either from the substantia nigra or ventral tegmentum. Both points will project their axons to the frontal lobes through (mesocortical system), limbic region (mesolimbic system), or basal ganglia (nigrostriatal system). This circle is extending from the ventral tegmentum of the midbrain & substantia nigra in the midbrain which passes through

nigrostriatal pathway to corpus striatum to nucleus accumbens, striatum, cingulate gyrus, and prefrontal cortex. There are two type of dopamine receptors which are D₁ and D₂. The antipsychotic medication can block 90% of the D₂ receptors [6]. Steven Yamen in molecular biology book stated that, if there is a lesion in the dopamine system, it will not be the primary cause of schizophrenia and there is no a compelling evidence to prove it [6]. The dopaminergic pathways is associated with addiction and schizophrenia as what will be mentioned subsequently in this paper.

Addiction & Gambling

During participation in using an addictive drug or in gambling, both will cause a release of dopamine in high amounts which will lead to euphoria. Cocaine stops nucleus accumbens from removing of the dopamine in synapses. In both situation (i.e. gambling or cocaine use) the blood flow will increase to the nucleus accumbens which can be detected by fMRI [16]. Similarly, nicotine connect Acetylcholine to nucleus accumbens’ receptors which allow dopamine release. Over time, drugs suppress the reward circuitry by inducing synaptic plasticity of the ventral tegmentum which increase the craving with withdrawal that requires an increase in the amount of the drugs to have the same euphoric effect which can lead to a drug overdose which could cause death eventually [16].

Déjà Vu

is when someone feels too had lived through the current situation before. This psychological phenomena can be normal or related to temporal lobe epilepsy which called ictal déjà vu. On any 18 FDG PET scan combined with an MRI scan for the temporal lobe in ictal déjà vu patient which can show the metabolism in region of interest (ROIs) in the temporal lobe [17]. The result showed a marked hypometabolism in the ROIs in temporal lobe in epilepsy patients with déjà vu [17].

Emotional Engagement (Sympathy and Empathy)

Dubbed mirror systems “mirror neurons” in inferior parietal cortex of the brain found to be activated on fMRI associated with empathy feeling [18]. Sympathy and empathy vary based on the level of engagement in other people suffering. As well, mirror neurons cause imitation of people like; when yawning upon seeing others yawn, crying when others cry, feeling happy when other laughing, etc. Mirror neuron has a relation with personality disorder (psychopath) and autism [18].

Infarctions

Many papers claimed that patients who had a stroke could develop depression [19, 20, 21]. By using medical imaging, Psychiatrists can identify the cause of depression in patients who had stroke in the past. By neglecting the use of medical imaging, Psychiatrists will waste their time trying to treat a patient without knowing the cause of this patient’s depression. Furthermore, not all strokes are symptomatic. Some of the strokes are asymptomatic which called “silent strokes”. Requesting a CT or an MRI scan can help in finding those silent strokes.

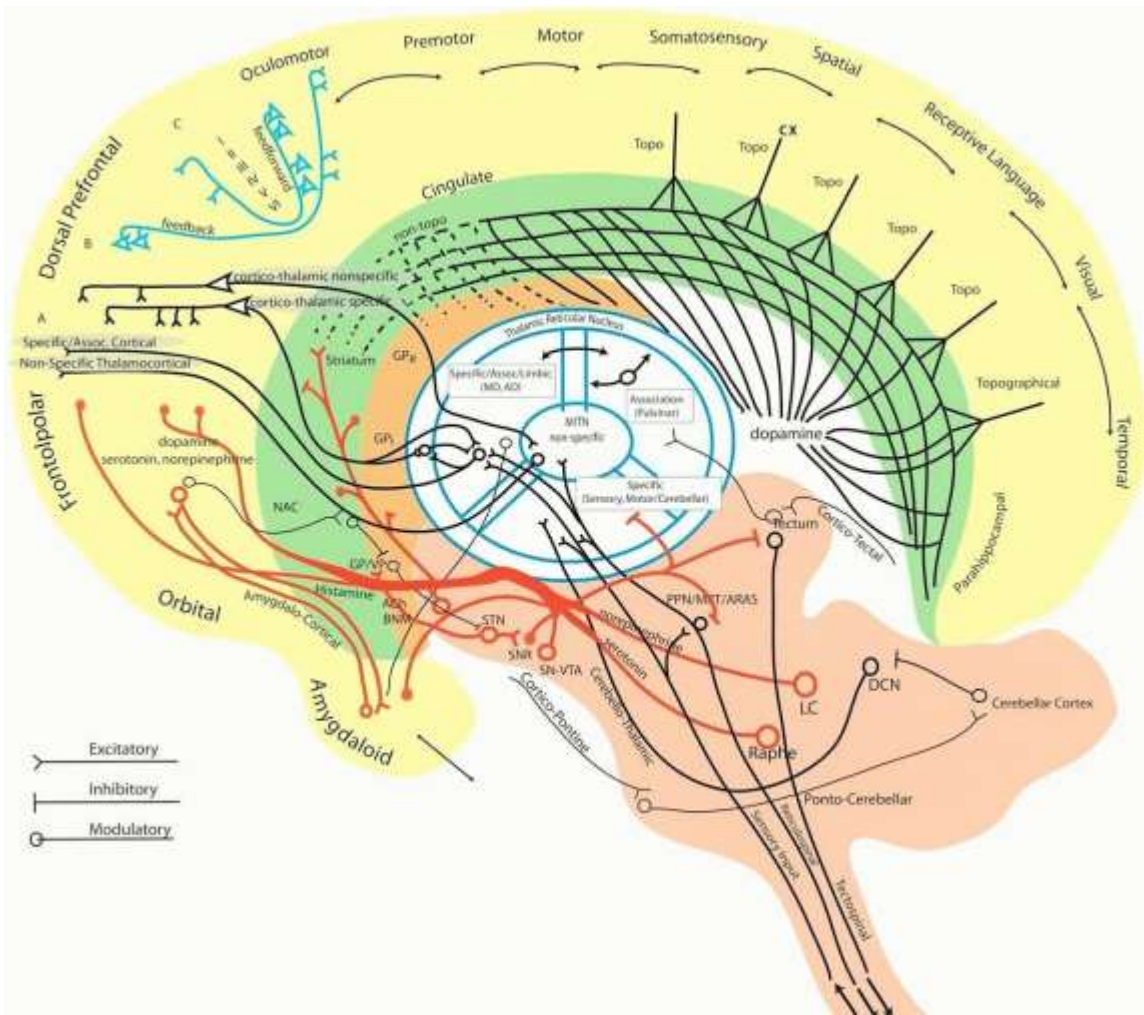


Figure 1: Pyramidal neurons’ pathways to the prefrontal cortex. List of abbreviations in the figure; DCN: dorsal cochlear nucleus, LC: locus coeruleus, Raphe: raphe nuclei cluster, PPN: pedunculo-pontine nucleus, MRT: medial reticular nucleus, ARAS: ascending reticular activating system, SN–VTA: substantia nigra–ventral tegmental area, SNR: substantia nigra pars reticulata, STN: subthalamic nucleus, ACh: acetylcholine, BNM: basal nucleus of Meynert, GP: globus pallidus, VP: ventral pallidum, MD: medial dorsal nucleus, AD: anterodorsal thalamic nucleus, MITN: midline thalamic nuclei, GPe: external globus pallidus, GPi: internal globus pallidus, and NAC: nucleus accumbens.

Neuroleptic Drug-Induced Brain Damage

The effect on a brain’s volume caused by anti-psychotic medications had been studied by using an MRI which revealed a frontal lobe atrophy with thalamic and basal ganglia swelling which caused by anti-psychotic medications [22]. This phenomena is known as “drug-induced brain damage” which occurs in tardive dyskinesia patients. The neuroleptic drugs can causes drug-related shrinkage which can be evaluated by MRI [22].

Meditation

The effect of meditation on the human brain can be seen in the amygdala by using fMRI. Amygdala is responsible for emotional responses, while cortex is responsible for logical response. Both PET and fMRI can show the blood distribution in the brain during meditation. Meditation is proven therapy for many illnesses (i.e. medical and mental like; gastric ulcer or anxiety respectively) and medical imaging can help in showing that effect

of meditation on the brain which support the usefulness of medical imaging in psychiatry and psychology.

The famous TV show called “Khawatir” presented by Ahmed Al-Shugairi on different channels in the Arab world about meditation during prayer showed a huge difference between focusing and meditating during a prayer on the brain. Ahmed did this experiment and it was reordered for the TV show “Khawatir”. Basically, Ahmed experiment was to undertake a SPECT scan then pray very fast without focusing, meditating, or connecting with God during the prayer then undertake a SPECT scan. After that, Ahmed went for a second prayer, but this time he was focusing, mediating, connecting with God, and thinking about nothing. The result on SPECT scans was astonishing. The SPECT scans showed no different in the pre and post praying the first time (the fast prayer), but the second prayer (meditating prayer) showed a change in the brain in three regions: the frontal lobe, basal ganglia, and parietal lobe which was confirmed by Dr. Andrew B. Newberg who is a specialist in neurological study of spiritual and religious experiences.

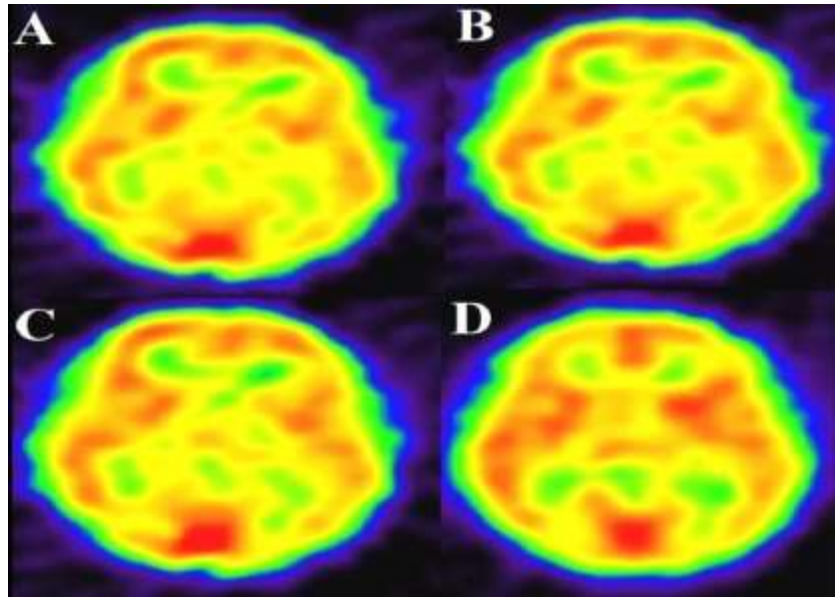


Figure 2: Ahmed's SPECT scan which was displayed publicly (Khawatir show; series 10; episode 10, 08 July 2014). The scan (A) was taken before the fast prayer, (B) was taken after the fast prayer, (C) was taken before the meditating prayer, and (D) was taken after the meditating prayer. The SPECT scan (A), shows no change, (B) shows no change, (C) shows no change, and (D) shows three huge changes: 1- the frontal lobe is less active due less thinking during the meditational prayer, 2- the basal ganglia is more active which is associated with reward system, compassion, and positive feelings, and 3- the parietal lobe is less active due loss of sense of self and the connection with God during worship.

Suicide

In a systematic review of 33 neuroimaging studies by using MRI, it was found that grey matter volume (GMV) reduction with cortical thinning of frontal and temporal lobes were found in and associated with suicidal patients [23]. As well, hippocampus is responsible for emotional responses and some of the published studies found that the hippocampus showed size reduction in suicidal patients compared to normal individuals. A simple brain MRI scan, can reveal the reasons behind patients' suicidal symptoms by measuring the gray matter volume, checking for any the cortical thinning, and measuring the hippocampal's volume which can help in determine the biological factors in suicide [23].

Sexual disorders

Gender identity disorder (GID) or gender dysphoria and homosexuality are classified according to Diagnostic and Statistical Manual of Mental Disorders (DMS) as mental disorders. Homosexuality has been proven that has no genetic basis [24]. Based on the brain sex theory, the GID patients have brain structure that is incompatible with same sex. There is a structure that has been associated with GID; stria terminalis which is a central subdivision of bed nucleus (BSTc) which in males is the twice size of the ones in females [25] (Zhou et al., 1997) and twice number of neurons [26] (Kruijver et al., 2000). As well, Kruijver et al (2000) found in BSTc of transsexuals contain the same number of neurons in females [26]. Both previously mentioned studies are cadaveric –post mortem– studies, but with advances in technologies of medical imaging, it could help in measuring the stria terminalis.

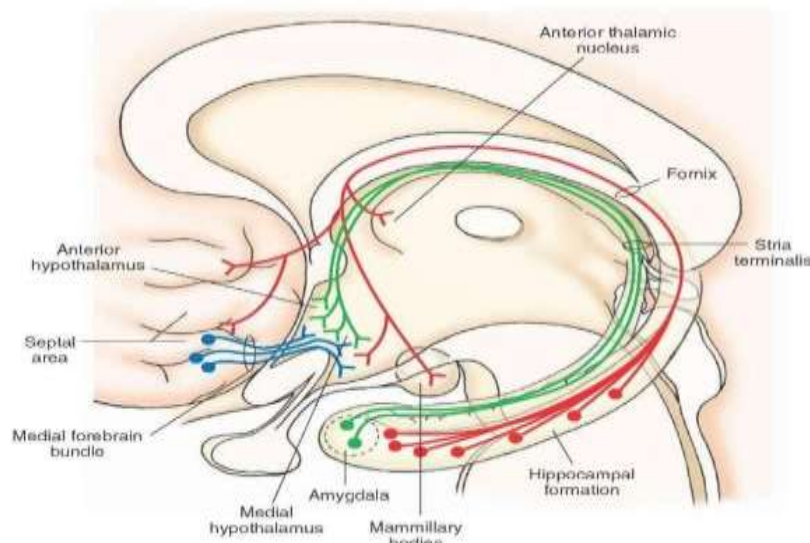


Figure 3: Illustration of anatomical structure and boundaries of stria terminalis.

Dementia

Dementia is a decline of mental functions like; memory, thinking, problem solving, perception, and concentration because of Alzheimer's disease, vascular dementia, etc. The neuroimaging role in diagnosing, staging, and evaluating dementia is very important. An article published in Scientific America magazine by "a science writer" where the writer claimed that brain scans can't help in psychiatry [28] and the author finished his article by stating list of diseases that can be diagnosed by brain scans including Alzheimer's disease which the primary cause of dementia! If there is a decline in the mental abilities, it's considered a mental illness. If medical imaging can help in diagnosing, staging, and evaluating a mental illness like dementia, but such arrogant, broad, and generalizing statements by the APA or Scientific America magazine

should not be made. Not to forget what Amen and others stated that the big failure of the APA in the last 40 years and how the APA made mental illnesses in America worse [6, 14, 29].

In Vivo Imaging of Neurotransmitters & Neuromodulators

Neurotransmitter is a chemical that transfers to a nerve, control muscle cell, or other structure, while neuromodulator is a chemical that control another neuron's function.

Based on the brain chemical imbalance theory, MRI and PET in vivo imaging have been developed to study the dynamic of the neuroreceptors and the levels of both neurotransmitters and neuromodulators [16].

Molecule pathway	Projection origin	Targeted areas
Dopamine (DA) Dopaminergic	Substantia nigra, pars compacta (SNc), ventral tegmental area (VTA)	Dorsal striatum Ventral striatum Frontal cortex
Serotonin (5-HT) Serotonergic	Dorsal raphe nucleus (DR) Median raphe nucleus (MR)	Cortex, striatum, cerebellum, hippocampus
Noradrenaline (NA) (Norepinephrine, NE) Noradrenergic	Locus nucleus (LC)	Cortex, hippocampus, cerebellum
Acetylcholine (Ach) Cholinergic pathway	Meynret nucleus (M) Medial septum (S) Pedunculopontine tegmental nucleus (PPTN)	Cortex, amygdala, hippocampus, pars compacta, thalamus, superior colliculus
Hypocretin/orexin Orexinergic	Nucleus basalis of Meynert perifornical area hypothalamus	Nucleus accumbanus, ventral tegmental area, raphe nuclei, locus ceoreleus
Histamine Histaminergic	Tubromammillary nucleus of hypothalamus	Cerebral cortex, striatum, posterior pituitary, medulla, cerebellum, ventral tegmentum, substantia nigra, midline thalamic area, hippocampus, amygdala
GABA Gabaergic	Thalamus and sub-thalamic nucleus	Striatum, globus pallidus, substantia nigra, cerebral cortex
Glutamate Glutamatergic	Cortical pyramidal neurons in the prefrontal cortex	Brainstem neurotransmitters centre, striatum, thalamocortical neurons to pyramidal neurons, thalamocortical neurons to thalamus, cortico to cortical pathway
Endorphins Endorphinic	Pituitary gland	Periaqueductal gray (PAG) area, descending to the rest of the body through spinal cord.
Oxytocin Oxytocinergic	Hypothalamus and secreted by posterior pituitary gland to the blood stream	Target accumbens nucleus, paraventricular nucleus, amygdala which are parts of the dopaminergic pathway

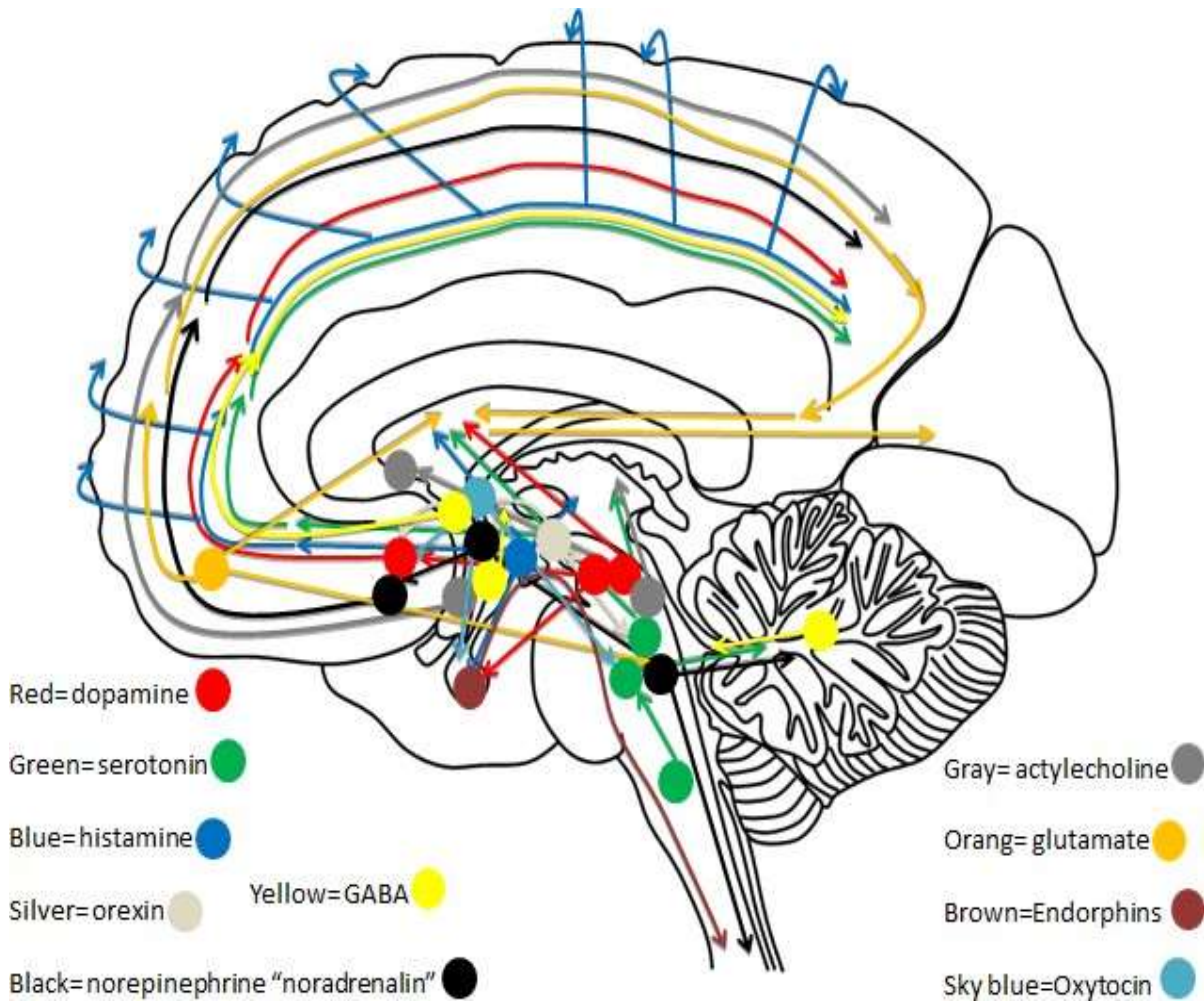


Figure 5: Major Neurochemical pathways in the brain. The circles are the centers of production of the chemical substances and the arrows are the pathways for those chemical substances.

Related Disease to Imbalance of Brain Chemical

Tourette’s syndrome (TS) is a neurodevelopmental psychiatric disorders which characterized by chronic tics [30]. Even though, motion artefact is an issue in such cases, but the usefulness of neuroimaging wither by MRI or PET scans’ both are useful. On MRI, subcortical regions, white matter, grey matter, brain connectivity in general were smaller in Tourette’s patients compared to normal individuals [30].

Medical Conditions Associated With Mental Illnesses

Corpus callosum agenesis is associated with many mental illnesses, but the most common one is schizophrenia [31]. It appears as “Moose head” sign on sagittal section and as “racing car” sign on coronal section of MRI scan (both are classic signs which easy to identify). It’s known that corpus callosum agenesis is association with depression, learning problems,

epilepsy, Asperger’s syndrome, conduct disorder, conversion symptoms, etc.

Schizophrenia can be caused by the following biological factors: cerebral lupus, Traumatic Brain Injury (TBI), brain tumor, subdural hematoma, pheochromocytoma, metachromatic leukodystrophy, HIV infection, Wilson disease, vitamin B12 deficiency, vitamin D deficiency, neurosyphilis, and dementia of any etiology, temporal lobe epilepsy, and multiple sclerosis [31]. Most of these etiologies can be diagnosed on neuroimaging scans [31].

Chronic Traumatic Encephalopathy (CTE) is associated with cognitive decline, dementia, suicide, low life quality due to chronic headache. CTE is caused by chronic TBI which appears as micro–bleeds in the brain which could be detected by MRI [32].

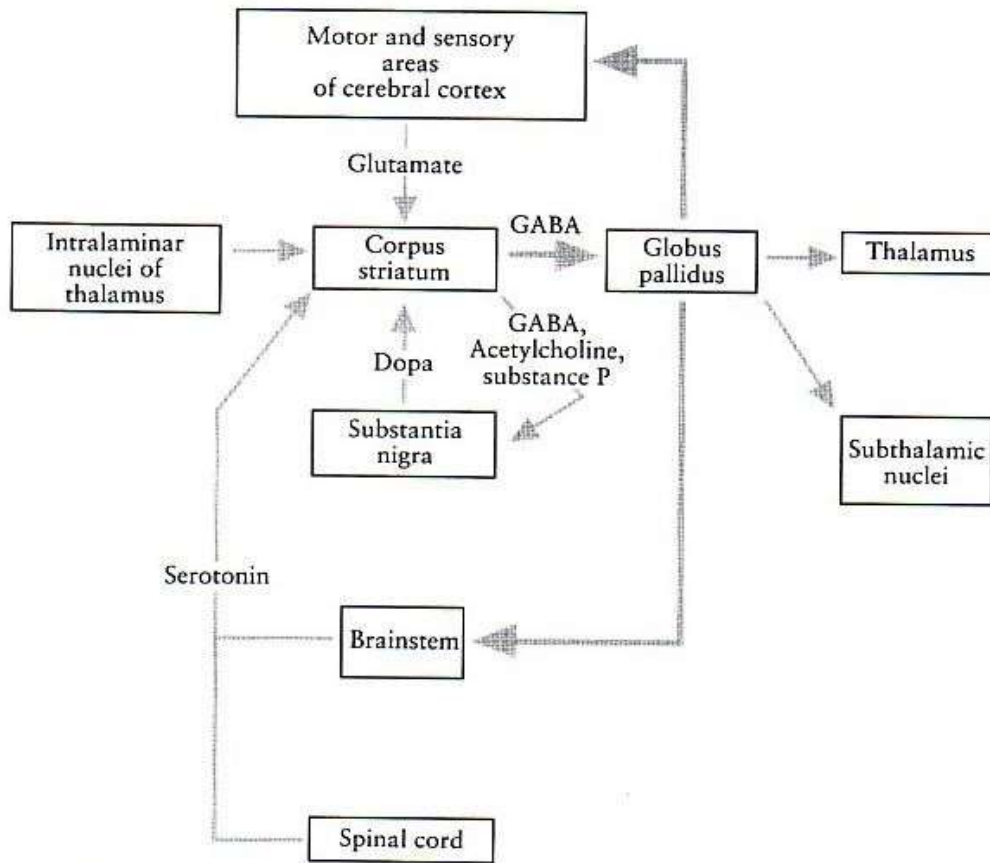


Figure 6: Basal nuclei pathways of the neurotransmitters associated with medical illnesses.

Parkinson's disease (PD) is characterized by decrease the dopamine levels only from substantia nigra to corpus striatum. The psychiatric disorders that are associated with PD include; delusion, apathy,

depression, anxiety, anhedonia, impulsive & compulsive behavior, hallucination, and cognitive dysfunction. Parkinson can be diagnosed by neuroimaging scans [33] see (Figure 6).

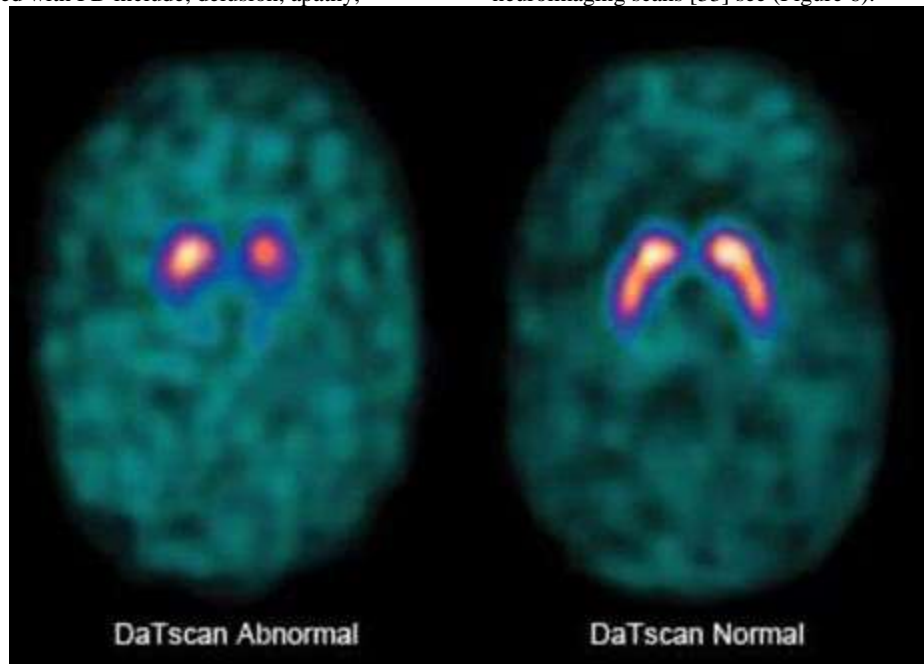


Figure 7: DaTscan for a Parkinson's patient on the left and normal brain on the right. This technique uses ioflupane (I123) which will connect to the dopamine transporters then imaged by SPECT/CT scanners.

Huntington's disease (HD) is characterized by decreasing levels of dopamine, GABA and P substance from corpus striatum to substantia nigra. The psychiatric disorders that are associated with HD include; irritability disorder, cognitive impairment, psychiatric disturbance, affective disorder, psychosis, and apathy [34].

Multiple Sclerosis (MS) is characterized by attacking the myelin sheath of the neurons in the central nervous system by the immune system (i.e. macrophages). The psychiatric disorders that are associated with MS include; anxiety, agitation, irritability, and dysphoria [35].

Neuroimaging Applications in Mental Illnesses

It has been proven that psychiatric disorders can affect the brain's morphology, neural circuits, and their activities. The following are some of the applications of neuroimaging in mental illnesses:

Schizophrenia

Bilateral ventricular enlargement is a classic sign for schizophrenia that were identified in the 70s [31]. Voxel-based morphometric changes usually found in the left medial lobe and superior temporal gyrus [31].

Depression

MRI voxel-based morphometric changes was detected in subgenual cingulate cortex and hippocampal's volume in depression patients who were treated with ElectroConvulsion Therapy (ECT) [36].

Bipolar I Disorder (Manic Depression)

Diffusion Tensor Imaging (DTI) of the whole brain showed white matter abnormalities in the corpus callosum, fornix, stria terminalis, and tapetum [37].

Borderline personality disorder

It is associated with decrease of the white matter's integrity in the cingulum and fornix [38, 39]. Abandonment avoidance and affective instability are associated with fractional anisotropy in the fornix [38, 39]. Anger emotion is associated with patients who have a fractional anisotropy in the cingulum [39].

Connectome and Childhood Development

Connectome (i.e. cortical connectivity networks) can help in monitoring of childhood development in the future to detect any change caused by mental illness.

Autism

Many sources classify this disease as neurological or developmental disorder due to its biological origin, but it still needs Psychiatrists, Psychologists, and Speech Therapists intervention in treating autism patients. The mental illnesses on the other hand, originated from the surrounding environment to acquire a mental illness where the autism is caused by biological factors. However, autism required cognitive therapy. Autism can be diagnosed on MRI scan [40].

Drug Abuse

The famous chicken or egg dilemma which presents the question which one came first? The chicken or the egg? The same scenario in psychiatry when ask the famous question "is mental illness cause drug abuse or drug abuse lead to mental illness?" A pregnant women who abuse drugs can cause neonatal abstinence syndrome which affect the mental health of the baby, but the mother abuse or dependence on a substance is due to her addiction which classified as mental illness by the DMS-5. In vivo imaging of neurotransmitters & neuromodulators are affected by using drugs which include illegal drugs, medications, other substances (i.e.

nicotine and alcohol). Furthermore, there are many papers claim that smoking marijuana can cause schizophrenia [13].

The Mind of a Dictator

There are two famous psychological experiments Stanford prison experiment and Milgram's experiment which demonstrates authority misuse and blind following of order. But yet nobody focused on the merciless dictators and horrible tyrants. A new theory mentioned by James Fallon that dictators probably have a prefrontal cortex damage that causes a lack of apathy. This can be detected on brain scans, but unfortunately no dictator has been undergo brain neuroimaging study before and shared the scan with Scientists.

Are mental illnesses biological in their kind?

The APA is claiming that mental illnesses are biological in their kind, but in the same time, they refuse to indicate the usefulness of medical imaging in detecting those illnesses. The APA is the one who supports the chemical imbalance theory and oppose the Freudian method (psychoanalysis) [29]. They encourage using the medications "magic bullets" instead of evaluating and exposing patients to their subconscious minds to find the reasons behind their mental illnesses [6].

The Author of "The Myth of Mental Illness" argue that mental illnesses are not biological in their kind [41]. Thomas Szasz (1961) in his book where he inspired the start of the antipsychiatry movement which oppose all of medications, electrical shocks, and lobotomy (i.e. psychosurgery). Szasz's friend (David Rosenhan), did a famous experiment that shocked the entire psychiatric field by sending 8 individuals to pretend to be sick (i.e. they should present one symptoms to the mental healthcare provider by saying they hear only the word "empty" which is "hearing hallucination") [42]. Then after they have been hospitalized they acted normal and showed no sickness, but they did not release them [42]. The number of pseudopatients is 8 and the number of mental facilities that were deceived is 12 hospitals [42]. The APA panicked because they can't differentiate between the mad and sane [42] by a scan, blood test, etc. The APA stood for David's published paper (on being sane in insane places which was published in the nature journal in that time) and the APA published a new manual that uses the tick-the-box approach which was introduced in 18th-century. If someone has 6 symptoms out of 10, this person will be diagnosed with the disorder that fits with the disorder's criteria [43]. One of the tricked hospital responded to Rosenhan and they challenged him to send the next month any pseudopatients he wants and the hospital will identify them. By the end of the month, the mental hospital declared that 41 pseudopatients were sent by Rosenhan and they were identified by the hospital. Rosenhan responded "I sent 0 pseudopatients which means the mental hospital let 41 sick patients out because they have no scientific criteria". Similar to what Rosenhan said, the Psychiatrists until today, they do not know the reasons that causes mental illnesses after 50 years from that time.

Mental illness' etiology could be a result of chemical imbalance, genetic, hormonal imbalance, electrical imbalance, altered brain temperature, metabolism imbalance, hormonal imbalance, environmental, prior negative experience, abnormal development, TBI, associated with other medical conditions, substance use, sole related spirituality (parapsychology), etc.

Pornography vs. Neuroplasticity

It is well known that addiction to watch pornography will cause change to the brain plasticity (neuroplasticity), gray matter to become thinner which will affect brain structures like the striatum which lead to the dysfunction reward system, low IQ, bad memory, unacceptable social behaviors, unsuccessful relationships, sexual dysfunction, etc. Brain plasticity can be evaluated by MRI [44].

Brain Calcification

Basal ganglia calcifications can be diagnosed on a CT scan and the calcification have been reported to be associated with psychosis and schizophrenia [45, 46]. Basal ganglia can be calcified in Fahr disease patients and other conditions.

Brain Morphology

There are neurological conditions that cause changes of the brain morphology. These neurological conditions have been reported to be associated with mental illnesses in the literature like; psychosis, schizophrenia, developmental language disorder, intellectual developmental disorder, mental disability (i.e. previously known as mental retardation), etc. These mental illnesses have been associated with a huge list of neurological conditions including; polymicrogyria, Dandy–Walker malformation, schizencephaly, microcephaly, megalencephaly, macrocephaly, hemimegalencephaly, syntelencephaly, colpocephaly, holoprosencephaly, porencephaly, dysgenesis or agenesis of corpus callosum or vermis, etc.

Neuropsychiatric As Specialty

Psychiatry should become more involved with neurology and psychoanalysis. All the psychiatric graduate programs should be renamed neuropsychiatry and it must be changed to study the neurological causes of mental illnesses. As well, it must focus on psychoanalysis to understand the emotional reasons behind any mental illness. All Psychiatrists must wait for 1 month period before prescribing any psychiatric medications for any patients which will affect the patient's live forever. Talking more with patients is the key to understand the reasons behind their sickness, to know their medical history, and to know their family's medical history. Focusing on treating the reasons is important than immediate treating of the symptoms by psychiatric medications and experimental cocktails which could make psychiatric patients more sick.

Conclusion

Neuroimaging can help in diagnosing and evaluating of mental illnesses. As well, neuroimaging can help in evaluating psychiatric medications' effects on the brain, and the finding associated medical illnesses with mental illnesses. Neuroimaging can bring more scientific approach to identifying a mental illness more than tick-the-box approach.

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