

Review of Approaches of Nuclear Medicine Images and Psychiatry

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Abstract

Nuclear imaging is used to diagnose or treat illnesses, those conditions have a multiple of consequences. It is important to note that few patients attending general medical settings who have a psychiatric disorder receive adequate treatment for it. The advent of cerebral single photon emission computed tomography made it possible. This work presents the use of nuclear medicine images in psychiatric diagnosis and in the following patient's psychiatric disturbs, helping the diagnosis and the early treatment of this diseases. Searched PubMed with the words: Nuclear Medicine Images or SPECT or Gamma Camara Images or Brain Images or Radiopharmaceuticals or Technetium-99m or HMPAO and Psychiatry. Articles as free full text, in Meta-Analysis, in Systematic Review, in the last 5 years, with research done in humans, written in English and founded in MEDLINE were searched. Two twenty three articles were founded. Nineteen works selected having the object of this study. Nuclear medicine images are a tool to diagnose and following the brains disturb giving to the physicians a good matter to treat

their patients. The psychiatric have a well-done work to do with this resource to treat and diagnostic his patients, following their evolution during the treatment with drugs or psychiatric way.

Keywords: Nuclear medicine; Diagnostic image; Psychiatry; Brain disturbs; PET; SPECT

Introduction

Nuclear medicine imaging is a method of producing images by detecting radiation from different parts of the body after a radioactive tracer is given to the patient [1]. The images are digitally generated on a computer and transferred to a nuclear medicine physician, who interprets the images to make a diagnosis [2]. Radioactive tracers or radiopharmaceuticals used in nuclear medicine are, in most cases, injected into a vein. For some studies, they may be given by oral *via* [3]. These tracers aren't dyes or medicines, and they have no side effects. The amount of radiation a patient receives in a typical nuclear medicine scan tends to be very low.

Nuclear imaging is used primarily to diagnose or treat illnesses [4]. Conditions diagnosed by nuclear medicine imaging include: blood disorders; thyroid disease, including hypothyroidism; heart disease; gallbladder disease; lung problems; bone problems, including infections or breaks; kidney disease, including infections, scars or blockages; cancer; and now psychiatric brain disturbs.

Nuclear medicine imaging can also be used to treat conditions or to evaluate how treatment is working. One example of this is radioimmunotherapy, which combines radiation and immunotherapy to deliver radiation precisely to a targeted area [5].

The main difference between nuclear medicine imaging and other radiologic test is that nuclear medicine imaging evaluates how organs function, whereas other imaging methods assess anatomy (how the organs look) [6]. The advantage of assessing the function of an organ is that it helps physicians make a diagnosis and plan treatments for the part of the body being evaluated.

Some people might be alarmed when they hear the word “radioactive”, but the tracers used aren’t medicines and almost don’t have side effects. In addition, the level of radiation in this kind of test tends to be very low. There is a very small chance that you might be allergic to the tracer. You should always make sure that your healthcare provider knows of any type of allergy you have. Nuclear medicine scans can provide important information that you can’t get from other types of testing. These scans can be used instead of exploratory surgery to improve diagnosis and treatment quality. Often, illnesses can be discovered in their earliest stages [7].

It is important to note that relatively few patients attending general medical settings who have a psychiatric disorder receive optimal or even adequate treatment for it. The obstacles of the effective management of psychiatric illness in medical patients may be considered.

Psychiatric diagnoses are frequently missed in medical patients [8]. There are a number of reasons for this: the patient may present with somatic complaints; the doctor may focus their attention on assessing or treating the patient’s medical condition rather than on their symptoms; the patient may be too embarrassed to discuss their psychological symptoms or fear the stigma of a psychiatric diagnosis; the doctor may be inadequately trained to assess psychiatric disorder or may be unwilling to make a potentially stigmatising diagnosis.

Two commonly held attitudes may prevent the physician actively treating the psychiatric disorder. First, they may regard it merely as a result of a medical condition and assume it does not require specific treatment preferring to assume the diagnosis only in a subjective way. Second, the

physician may erroneously believe that psychiatric treatment would be ineffective in any case, and is therefore pointless. These attitudes are compounded by a lack of psychiatric training, expertise, time and facilities in the non-psychiatric parts of the healthcare system [9].

Even when a psychiatric disorder has been diagnosed and treatment commenced, effective management may fail because the patient’s symptoms and response to treatment are not monitored [10-12]. The patient may stop taking medication because of side-effects or because they believe it to be unhelpful, or they may not receive an adequate dose of medication for a sufficient time. Without regular monitoring, medication is not adjusted appropriately and referral to specialist psychiatric or psychological services is not made.

It is usual in psychiatric clinic arise diagnostic hypothesis for the same patient. The advent of cerebral single photon emission computed tomography made it possible the formation of Data Bank [13]. The Single-Photon Emission Computed Tomography (SPECT) when made cerebral images is known as cerebral perfusion scintigraphy, it is done with a drug that in minute fraction is extracted of blood to the interior of the neurons, through the haemato-encephalic barrier, still there for hours. The psychiatry is one the more needy medical specialities, in terms of complementary examinations, and the cerebral SPECT done with HMPAO could be used to help the clinician in doubt cases [14].

With this point of view, we try to present in this work the use of nuclear medicine images in psychiatric diagnosis and in the following patient’s psychiatric disturbs, helping the diagnosis and the early treatment of this diseases.

Methods

PubMed (www.pubmed.com) is a free resource supporting the search and retrieval of biomedical and life sciences literature with the aim of improving health-both globally and personally. The PubMed database contains more than 34 million citations and abstracts of biomedical literature. It does not include full text journal articles; however, links to

the full text are often present when available from other sources. We searched in PubMed with the words: Nuclear Medicine Images or SPECT or Gamma Camera Images or Brain Images or Radiopharmaceuticals or Technetium-99m or HMPAO and Psychiatry. Articles published as free full text, in Meta-Analysis, in Systematic Review, in the last 5 years, with research done in humans, written in English and founded in MEDLINE were searched. We founded Two twenty three articles with this type of research. We selected Nineteen works that they were the object of this study.

Results

The articles searched in PubMed were showed in the Figure 1 with their prevalence in the last 5 years of the research and found Two twenty three articles. Of which, one hundred and

nineteen articles were about the use of NM in the study and diagnostic of different manifestations of cancer, sixty one about another the use of radiopharmaceutical in diagnostic different diseases, thirteen were about something kind of manifestation problem in the body, such as, osteomyelitis, coronary disease, between other manifestation, Five were about other organs diseases as pulmonary infection, and another three works covering use of NMI in study dopaminergic syndrome and Tourette. We found twenty two works written about psychiatric conditions. Alzheimer (7), or Parkinson (6), or ADHA (1), or dementia (4), or epilepsy (1), or psychosis (2), or obsessive compulsory disease (1), were some of those conditions and presenting NMI evaluations and were considered to this work (Table 1).

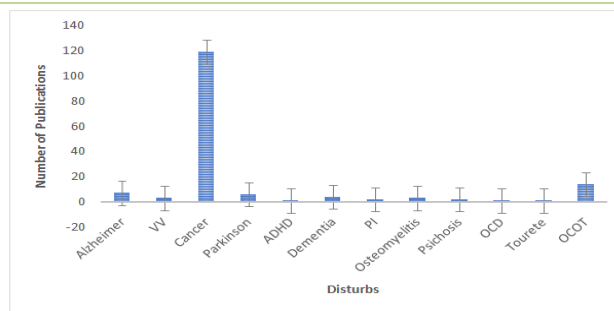


Figure 1: Types of disturbs publications with 5 years of research cited on PubMed

VV - Vessel Vasculitis; ADHD - Attention Deficit/ Hyperactivity Disorder; PI - Pulmonary Inflammation; OCD - Obsessive Compulsive Disorder; OCOT - Other’s Cited One Time.

Table 1: The principal characteristics of the works searched.

Article	Objective	Methods	Results	Conclusion
Carey G, et al. 2021 [15]	Systematic review was to identify the brain regions involved in anxiety in Parkinson’s disease based on neuroimaging studies and to interpret the findings against the background of	Studies assessing anxiety symptoms in PD patients and studies using magnetic resonance imaging, positron emission tomography, or single photon emission computed tomography were included	Reduced gray-matter volume of the amygdala and the anterior cingulated cortex; an increased functional connectivity and the cortico-striato-thalamocortical limbic circuit were reported.	Anxiety is associated with structural and functional changes in both the hypothesized fear and the limbic cortico-striato-thalamocortical circuits.

	dysfunction of the fear circuit and limbic cortico-striato-thalamocortical circuit			
Chen H-M, 2017 [16]	Deep brain stimulation of the sub thalamic nucleus (STN-DBS) has become an effective treatment strategy for patients with Parkinson's disease.	13 PET/SPECT studies concerning STN-DBS effects on resting-state brain activity in Parkinson's disease, and also investigated whether these affected regions were functionally connected to constitute an effective network.	STN-DBS reduced brain activity in the right thalamus, bilateral caudal supplementary area, and the left primary motor cortex, and it increased brain activity in the left thalamus during rest.	It shed light on the mechanisms of STN-DBS treatment from a network perspective and highlights the potential therapeutic benefits of targeted network modulation.
Ghaffari-Rafi, 2020	The objective of this systematic review is to elucidate what diagnostic pathways clinicians globally utilize.	Utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) and the Cochrane Handbook of Systemic Reviews of Interventions, we conducted a systematic review through MEDLINE, Embase, and CENTRAL.	All but two articles required neuropsychological assessment. Six required neuropsychiatric assessment. Two protocols mentioned assessing the patient's support network. One an occupational evaluation and making all surgery decisions in a multidisciplinary management conference. Magnetic Resonance (MR) spectroscopy was required at two institutes.	Socioeconomic restrictions appear to play a role in determining which tests are utilized in the investigatory pathway not just for developing countries. Overall, even amongst expert examiners there is significant variation throughout epilepsy centres globally, in selecting candidates and working up patients.
Raghavan NS, 2020 [21]	To examine the underlying genetic basis for brain amyloidosis in the preclinical phase of Alzheimer disease.	The Anti-Amyloid Treatment in Asymptomatic Alzheimer Disease Study (n = 3154), was the PET screening. Six smaller, longitudinal cohort studies (n = 1160) provided	4314 analyzed participants, a novel locus for amyloidosis was noted within RBFOX1 ($\beta = 0.61$, $P = 3 \times 10^{-6}$) in addition to APOE. The RBFOX1 protein localized	The findings of this study suggest that RBFOX1 is a novel locus that may be involved in the pathogenesis of

		additional amyloid PET imaging data with existing genetic data.	around plaques, and reduced expression of RBFOX1 was correlated with higher amyloid- β burden and worse cognition during life in the Religious Orders Study and Rush Memory and Aging Project cohort.	Alzheimer disease.
Hirjak D, 2020 [40]	We undertook a systematic review searching for neuroimaging studies using motor/behavioural catatonia rating scales/criteria and NCRS published up to March 31, 2019.	19 neuroimaging studies. Studies using motor/behavioural catatonia rating scales/criteria depict cortical and sub cortical motor regions mediated by dopamine as neuronal and biochemical substrates of catatonia.	Studies relying on NCRS found rather aberrant higher order frontoparietal networks which, biochemically, are insufficiently modulated by gamma-aminobutyric acid (GABA)-ergic and glutamatergic transmission.	In sum, this systematic review points out the difference between motor/behavioural and NCRS based classification of catatonia on both neuronal and biochemical grounds.
Jiang L, 2020 [17]	The purpose of this study is to evaluate the efficacy of 11C-CFT PET combined with 18F-FDG PET in the diagnosis of early PD.	We will search 7 electronic databases (PubMed, EMBASE, Web of Science, Cochrane library, PsycINFO, AMED, and Scopus), ongoing trials and grey literature to collect related randomized controlled trials and will use Review Manager Software 5.2 and STATA Software 16.0 for analysis and synthesis.	We will integrate the existing randomized controlled trials to evaluate the value of 11C-CFT PET combined with 18F-FDG PET in the diagnosis of early PD.	Our study may prove that 11C-CFT PET combined with 18F-FDG PET can effectively diagnose early PD.
Kaasinen V, 2019 [18]	We compared striatal presynaptic dopaminergic function in MSA Parkinsonism variant (MSA-P), MSA cerebellar variant (MSA-C), PSP, CBS, and PD using combined	The PubMed database was searched from inception to August 2018 for the terms “dopamine” OR “dopaminergic” AND “PET” OR “SPECT” OR “SPET” and keywords related to PD, MSA, PSP, and CBS. In total, 1,711 publications were identified.	Thirty-five studies with 356 MSA-P patients, 204 PSP patients, 79 CBS patients, and 62 MSA-C patients were included in the met analysis. Caudate nucleus and putamen DAT function was clearly lower in PSP than in PD and MSA-P and was clearly lower in MSA-P than in MSA-C.	Striatal presynaptic DAT function is clearly lower in PSP patients than in PD and MSA-P patients and is clearly lower in MSA-P patients than in MSA-C patients

	quantitative data from all published studies.		Although not significant because of limited data, aromatic L-AADC results paralleled the DAT findings.	
Kong Y, 2020 [19]	We aimed to conduct a meta analysis to assess the efficacy of using 18F-FP-CIT positron emission tomography (PET) and 123I-FP-CIT single photon emission computed tomography (SPECT) of dopamine transporters in patients with PD in order to provide evidence for clinical decision-making.	Searched the PubMed, Embase, Wanfang Data, and China National Knowledge Infrastructure databases to identify the relevant studies from the time of inception of the databases to 30 April 2020. Six PET studies, including 779 patients with PD and 124 healthy controls, which met the inclusion criteria.	Patients with PD showed significantly reduced 18F-FP-CIT uptake in three brain regions [caudate nucleus, anterior putamen, and posterior putamen. Significant decreases of 123I-FP-CIT uptake were also observed in the caudate and putamen.	Our findings indicate that both 18FFP-CIT PET and 123I-FP-CIT SPECT imaging of dopamine transporters can provide viable biomarkers for early PD diagnosis.
Kunkle BW, et al 2019 [22]	To identify LOAD risk loci, we performed a large genome-wide association meta analysis of clinically diagnosed LOAD (94,437 individuals).	Identify 20 previous LOAD riskloci and new genome-wide loci (IQCK, ACE, ADAM10, ADAMTS1, and WWOX), two of which (ADAM10, ACE) in a recent genome-wide association (GWAS)-by-familial proxy of Alzheimer's or dementia. The neurological and immune-mediated disease haplotype HLA-DR15 as a risk factor for LOAD.	Pathway analysis implicates immunity, lipid metabolism, tau binding proteins, and Amyloid Precursor Protein (APP) metabolism, showing that genetic variants affecting APP and A β processing are associated not only with early-onset autosomal dominant Alzheimer's disease but also with LOAD.	Analyses of risk genes and pathways show enrichment for rare variants ($P = 1.32 \times 10^{-6}$), indicating that additional rare variants remain to be identified.

Martinez G, 2017 [23]	To determine the DTA of the F-flutemetamol PET scan for detecting people with MCI at time of performing the test who will clinically progress to ADD, other forms of dementia (non-ADD) or any form of dementia at follow-up.	We searched MEDLINE, Embase, PsycINFO, BIOSIS Citation Index, Web of Science Core Collection, including the Science Citation Index and the Conference Proceedings Citation Index, LILACS, CINAHL, ClinicalTrials.gov, and the World Health Organization International Clinical Trials Registry Platform, ALOIS, the Cochrane Dementia & Cognitive Improvement Groups specialised register of dementia studies. Using the Science Citation Index identifying any additional relevant studies.	It was evaluated in 243 participants from two studies. The studies reported data on 19 participants with two years of follow-up and on 224 participants with three years of follow-up. Nine participants converted at two years follow-up and 81 converted at three years of follow-up. Progression from MCI to ADD at two years of follow-up had a sensitivity of 89% and a specificity of 80%. Progression from MCI to ADD at three years of follow-up had a sensitivity of 64% and a specificity of 69% by visual assessment.	We cannot recommend routine use of F-flutemetamol in clinical practice. F-flutemetamol has high financial costs; therefore, clearly demonstrating it's DTA and standardising the process of the F-flutemetamol modality is important prior to its wider use.
Meyer PT, 2017 [20]	Oriented review on the use of 18F-FDG PET in neurodegenerative parkinsonism provides the clinical practitioner with an update on the clinical demand and rationale for 18F-FDG PET imaging in parkinsonism, typical 18FFDG PET patterns and their value for differential diagnosis of parkinsonism, and an outlook on the	Review of the literature about the use of 18F-FDG PET in diagnosis parkinsonism.	Taken together, these findings indicate that posterior cortical hypometabolism has an importance of which the nuclear medicine practitioner should be aware.	Although it is probably premature to propose clinical use of posterior cortical hypometabolism as a predictor of cognitive decline in PD, this finding may prompt further examinations and special consideration under specific circumstances.

	promising role of 18F-FDG PET for diagnostic assessment and risk stratification in cognitive impairment in Parkinson disease.			
Mondragón JD, 2019 [24]	A systematic review of this literature was performed, following the Preferred Reporting Items for Systematic Reviews and Meta Analyses statement, on PubMed, EMBASE, and PsycINFO databases.	Reporting Items for Systematic Reviews and Meta Analyses statement, on PubMed, EMBASE, and PsycINFO databases.	Twenty-five articles met all inclusion criteria. Specifically, four brain connectivity and 21 brain perfusions, metabolism, and activation articles.	Although the current evidence suggests differences in activation between AD or MCI patients with anosognosia and healthy controls, more evidence is needed exploring the differences between MCI and AD patients with and without anosognosia using resting state and task related paradigms.
Muñoz-Neira C, 2019 [41]	A systematic review to explore the neural correlates of altered insight in FTD and associated syndromes was conducted. Insight was fractionated to examine whether altered insight into different neuropsychological/behavioural objects is underpinned by different or compatible neural	6 databases (Medline, Embase, PsycINFO, Web of Science, BIOSIS and ProQuest Dissertations & Theses Global) were interrogated between 1980 and August 2019.	15 relevant papers were found out of 660 titles screened. The studies included suggest that different objects of altered insight are associated with distinctive brain areas in FTD.	These results reflect to a certain extent those observed in other neurodegenerative conditions like Alzheimer's disease (AD) and also other brain disorders. Nevertheless, they should be cautiously interpreted due to variability in the methodological aspects used to reach those conclusions.

	correlates.			
Ossenkoppele R, et al 2021 [25]	To perform a systematic review and meta-analysis of the bvAD literature and use the outcomes to propose research criteria for this syndrome.	A systematic literature duplicate search in PubMed/MEDLINE and Web of Science databases. Studies reporting on behavioural, neuropsychological, or neuroimaging and, when available, providing comparisons with typical amnesic predominant or behavioural variant frontotemporal dementia. This analysis involved random-effects meta-analyses on group-level study results of clinical data and systematic review of the neuroimaging literature, and following Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.	83 studies, including 13 suitable for meta-analysis. Data were collected for 591 patients. Cases with bvAD showed more severe behavioural symptoms than tAD and a trend toward less severe behavioural symptoms compared with bvFTD Meta-analyses of cognitive data indicated worse executive performance in bvAD vs tAD but not compared with bvFTD Cases with bvAD showed a non significant difference of worse memory performance compared with bvFTD but did not differ from tAD The literature revealed 2 distinct bvAD neuroimaging phenotypes: an AD-like pattern with relative frontal sparing and a relatively more bvFTD-like pattern.	These data indicate that bvAD is clinically most similar to bvFTD, while it shares most pathophysiological features with tAD. Based on these insights, we propose research criteria for bvAD aimed at improving the consistency and reliability of future research and aiding the clinical assessment of this AD phenotype.

Discussion

In the revised literature six works were about Parkinson disease [15,16-20] seven were about Alzheimer [21-27], two were about psychosis [28,29], and only one was about epilepsy or ADHA or dementia or obsessive-compulsive disorder.

As we know, the substantia nigra is the black substance because the presence of melanin pigment causes it to appear black to the naked eye. It has two parts, one of which is functionally equivalent to the globus pallidus interna. The other part degenerates in Parkinson’s disease. Parkinsonism

is characterized by rigidity and tremor and is associated with depression in more than 30 percent of cases [30]. All the searched works about Parkinson disease [15-20] were agreed to affirm the characteristics of the disease in nuclear medicine images were anxiety [15], stimulation of subthalamic nucleus [16], well diagnostic by these methods [17-19], and the cognitive impairment [20].

The most common clinical disorder of memory is Alzheimer’s disease. Alzheimer’s disease is characterized pathologically by the degeneration of neurons and their replacement by senile plaques and neurofibrillary tangles

[31]. Clinicopathological studies have suggested that the cognitive decline is best correlated with the loss of synapses [32]. Initially, the parietal and temporal lobes are affected, with relative sparing of the frontal lobes. This pattern of degeneration correlates with the early loss of memory, which is largely a temporal lobe function [33]. Also, syntactical language comprehension and visuospatial organization, functions that rely heavily on the parietal lobe, are impaired early in the course of Alzheimer's disease. In contrast, personality changes, which reflect frontal lobe function, are relatively late consequences of Alzheimer's disease. There is an association with a genetic basis for brain amyloidosis [21], or dementia [22,23], or correlation with anosognosia [24]. A behavioural variant was founded [25] and the association with ribosomal genes that increases the microglial activation [24]. This disease could be followed by nuclear medicine images to confirm the diagnosis [27].

The word psychosis is used to describe conditions that affect the mind, where there has been some loss of contact with reality [34]. When someone becomes ill in this way it is called a psychotic episode. During a period of psychosis, a person's thoughts and perceptions are disturbed and the individual may have difficulty understanding what is real and what is not. Symptoms of psychosis include delusions (false beliefs) and hallucinations (seeing or hearing things that others do not see or hear). Other symptoms include incoherent or nonsense speech, and behaviour that is inappropriate for the situation [35]. A person in a psychotic episode may also experience depression, anxiety, sleep problems, social withdrawal, lack of motivation, and difficulty functioning overall [36]. Positron emission tomography studies determinate the glial protein translocation [28] and dopaminergic alterations [29] in patients with psychosis characteristics, showing that the use of nuclear medicine images could be a tool in the diagnosis of the disturb.

Epilepsy is a disorder of the brain characterized by repeated seizures [37]. A seizure is usually defined as a sudden alteration of behaviour due to a temporary change in the

electrical functioning of the brain. The use of SPECT is a tool for the ancillary diagnosis [38].

ADHD can last into adulthood. Some adults have ADHD but have never been diagnosed [39]. The symptoms can cause difficulty at work, at home, or with relationships. Symptoms may look different at older ages, for example, hyperactivity may appear as extreme restlessness. Symptoms can become more severe when the demands of adulthood increase [40].

Dementia is the loss of cognitive functioning - thinking, remembering, and reasoning to such an extent that it interferes with a person's daily life and activities. Some people with dementia cannot control their emotions, and their personalities may change [41].

Obsessive Compulsive Disorder (OCD) is a disorder in which people have recurring, unwanted thoughts, ideas or sensations (obsessions) that make them feel driven to do something repetitively (compulsions). The repetitive behaviours, such as hand washing, checking on things or cleaning, can significantly interfere with a person's daily activities and social interactions [42].

Many people without OCD have distressing thoughts or repetitive behaviours. However, these thoughts and behaviours do not typically disrupt daily life. For people with OCD, thoughts are persistent, and behaviours are rigid. Not performing the behaviours commonly causes great distress. Many people with OCD know or suspect their obsessions are not realistic; others may think they could be true (known as limited insight) [43]. Even if they know their obsessions are not realistic, people with OCD have difficulty disengaging from the obsessive thoughts or stopping the compulsive actions.

All those brains disturb were following by nuclear medicine images and helped the psychiatric to made a correct diagnostic about the disease that committed the brain of those people, and also helped for the evolution of the treatment.

Conclusion

Nuclear medicine images are a tool to diagnose and following the brains disturb giving to the physicians a good matter to treat their patients. The psychiatric have a well-done work to do with this resource to treat and diagnostic his patients, following their evolution during the treatment with drugs or psychiatric way.

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