

تطوير التشخيص والعلاج النفسي من خلال التصوير المقطعي المحوسب
**Advancing Psychiatric Diagnosis and Treatment through
SPECT Imaging**

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**Keywords: SPECT, Psychology, Brain Pathology, Biomarkers,
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Abstract:

This research explores the transformative potential of Single Photon Emission Computed Tomography (SPECT) imaging in revolutionizing psychiatric diagnosis and treatment. By offering unique insights into brain function, SPECT imaging presents a valuable adjunct to traditional psychiatric assessments, enhancing diagnostic accuracy and treatment outcomes. We believe in the role of SPECT imaging in visualizing brain pathology and biomarkers associated with mental health disorders, facilitating early detection, personalized treatment planning, and monitoring of therapeutic interventions. Despite challenges such as limited spatial resolution and interpretation complexities, SPECT imaging holds promise as a powerful tool in elucidating the neurobiological underpinnings of psychological conditions. Through case studies and research findings, this review underscores the potential of SPECT imaging to bridge the gap between subjective assessments and objective measures, driving innovation in psychiatric care and improving the lives of individuals affected by mental illness.

يهدف هذا البحث إلى الكشف عن الإمكانيات التحويلية للتصوير المقطعي المحوسب بانبعاث الفوتون الفردي في إحداث ثورة في التشخيص والعلاج النفسي من خلال تقديم رؤية فريدة حول وظائف المخ. يقدم التصوير المقطعي المحوسب أداة مساعدة قيمة لتقييمات الطب النفسي التقليدية، مما يعزز دقة التشخيص ونتائج العلاج. نحن نؤمن بدور التصوير المقطعي المحوسب في تصور أمراض الدماغ والمؤشرات الحيوية المرتبطة باضطرابات الصحة العقلية، وتسهيل الكشف المبكر، وتخطيط العلاج الشخصي، ومراقبة التدخلات العلاجية. على الرغم من التحديات مثل الدقة المكانية المحدودة وتعقيدات التفسير، فإن التصوير المقطعي المحوسب يبشر بالخير كأداة قوية في توضيح الأسس العصبية الحيوية للحالات النفسية. من خلال دراسات الحالة ونتائج البحوث، تؤكد هذه المراجعة على قدرة التصوير المقطعي المحوسب على سد الفجوة بين التقييمات الذاتية والتدابير الموضوعية، مما يدفع الابتكار في مجال الرعاية النفسية وتحسين حياة الأفراد المتأثرين بالأمراض العقلية.

Introduction:

Exploring the potential of using Single Photon Emission Computed Tomography (SPECT) scans in diagnosing and monitoring psychotherapy outcomes. Since SPECT imaging offers a unique perspective on brain activity and can provide valuable insights into the neural mechanisms underlying various mental health conditions. By incorporating SPECT scans into psychotherapy assessments, clinicians may be able to tailor treatment plans more effectively and track changes in brain function over time. This abstract highlights the promising applications of SPECT imaging in the field of psychotherapy for improved diagnostic accuracy and treatment outcomes considering the challenges associated with using SPECT.

A Single Photon Emission Computed Tomography (SPECT) scan is a type of nuclear three-dimensional imaging test that uses radioactive tracers to create detailed images of the brain's blood flow and activity, SPECT scans are more focused on assessing brain function rather than providing detailed structural Information as other imaging techniques like MRI or CT scans that are used for visualizing the brain's structural anatomy. The pathology of the brain and psychological disorders involves studying how abnormalities in brain structure and function can contribute to the development of mental health conditions. Research has

shown that various factors, such as genetics, environment, and brain chemistry, can play a role in the onset of psychological disorders like depression, anxiety, schizophrenia, bipolar disorder, and others. Pathologists examine brain tissue and imaging studies to identify changes in the brain that may be associated with these disorders, such as alterations in neurotransmitter levels, brain regions, or blood flow. Understanding the pathology of the brain in relation to psychological disorders can help researchers and healthcare professionals develop more effective treatments and interventions to improve the lives of individuals affected by these conditions.

In clinical settings, psychologists usually use subjective methods, such as interviews, observations, and self-report measures, to gather information about a person's thoughts, feelings, and behaviors. This subjective data helps psychologists understand an individual's experiences from his own perspective only. The information given may be inconsistent, lacking details, incorrect, or the patient might even overlook a crucial part of their experience. These occurrences can happen consciously or unconsciously, with some being influenced by the individual's defense mechanisms and other contributing factors.

“Psychiatrists remain the only medical specialists that never look at the organ they treat.” This statement, from the Article of psychiatrists Daniel Amen (amen, 2010) demonstrates how a psychiatrist's method of diagnosing diseases remains separate from other medical professions methods of diagnosis, this absence of a direct physical examination for the main organ may result in the loss of important components that could aid in a more accurate diagnosis and course of therapy.

Identifying biomarkers related to brain pathology can help improve the diagnosis and treatment of mental health disorders. SPECT imaging can be used to visualize blood flow and activity in the brain, providing valuable information about brain function and potential abnormalities.

However, the use of SPECT imaging comes with certain limitations that need to be addressed. These include challenges such as limited spatial resolution, radiation exposure, availability constraints, interpretation complexities, and cost considerations. Understanding and addressing these limitations is essential for optimizing the use of SPECT scans in psychiatric research and clinical practice.

Brain Pathology and Biomarkers

Brain pathology refers to any abnormal condition or disease affecting the brain, including structural, biochemical, or functional abnormalities. Brain pathology can result from a different causes, including genetics, traumatic injury, neurodegenerative diseases, and psychiatric disorders.

Biomarkers are measurable indicators of biological processes or conditions, often used to detect, diagnose, or monitor diseases. Biomarkers can provide valuable information about the presence, severity, progression, or response to treatment of various brain-related conditions. Biomarkers associated with brain pathology can include genetic markers, proteins, metabolites, imaging markers, and cognitive or behavioral measures.

The relationship between brain pathology and biomarkers is crucial for several reasons:

1-Early Detection and Diagnosis: Biomarkers can help identify brain pathology at earlier stages, sometimes before symptoms become clinically apparent. Early detection allows for timely intervention and treatment, potentially improving outcomes for individuals with brain disorders.

2-Disease Monitoring and Progression: Biomarkers can be used to monitor the progression of brain pathology over time. By tracking changes in biomarker levels or patterns, clinicians can assess disease severity, predict prognosis, and adjust treatment strategies accordingly.

3-Treatment Response: Biomarkers can indicate whether a particular treatment is effective in addressing brain pathology. Monitoring biomarker levels or changes during treatment can help evaluate treatment response and guide decisions about adjustments or alternative therapies.

4-Precision Medicine: Biomarkers can facilitate the development of personalized treatment approaches tailored to an individual's specific brain pathology and biological characteristics. This concept, known as precision medicine or personalized medicine, aims to optimize treatment efficacy while minimizing adverse effects.

For example, in depression, reduced activity in the prefrontal cortex and increased activity in the limbic system (such as the amygdala) may be observed. These biomarkers can inform treatment strategies aimed at regulating mood and improving emotional regulation.

In schizophrenia, abnormalities in multiple brain regions, including the prefrontal cortex and temporal lobes, may be detected. Understanding these biomarkers can aid in early detection, monitoring progression, and optimizing medication management and psychotherapy approaches.

Understanding the relationship between brain pathology and biomarkers is essential for growing knowledge about brain disorders, improving diagnostic accuracy, optimizing treatment strategies, and ultimately enhancing outcomes for individuals affected by these conditions.

SPECT imaging can also reveal structural and functional abnormalities in the brain that are indicative of pathology. For instance:

In traumatic brain injury (TBI), SPECT scans can detect areas of hypo-perfusion (reduced blood flow) or hyper-perfusion (increased blood flow) in regions affected by injury. This information can guide rehabilitation efforts and help predict outcomes.

SPECT and SPECT steps

SPECT scans measure the functional activity of the brain by taking a radioactive tracer that monitors regional cerebral blood flow. The spectrum shows how well the organs are working. This type of imaging can show areas of the brain that are more or less active. SPECT can create a detailed 3D map of the blood circulation that helps show which parts of the brain are damaged, SPECT also can provides a 10-15 minute activity picture which makes it unique in front of Similar imaging techniques The SPECT image is more appropriate to detect brain abnormalities in SD patients than morphological tests such as CT or MRI, given the functional nature of the postulated disturbance (in all the cases in which SPECT showed abnormalities both CT and MRI were normal) (Garcia-Campayo, 2001).

Applying SPECT go through four steps that can be summarized by these four stages:

1. Radioactive tracer is injected into the bloodstream.
2. Gamma camera detects the gamma radiation emitted by the patient.
3. Cameras collect data on the distribution and intensity of gamma radiation from different angles.
4. Gamma- cameras collect data and send them to the computer.

The SPECT database

A unique searchable database of nearly 100,000 functional brain scans related to patient behavior from 111 countries is now poised to change the way psychiatry has been practiced for the past 170 years. Amen Clinics - A group of six psychiatric clinics nationwide, founded in 1989 by psychiatrist Daniel G. Amen, M.D. Established the world's largest SPECT image database, with data from patients aged 9 months to 101 years (LLC, Oct 13, 2014). This makes it an important reference for those who believe that time has come to where diagnosing and treatment in psychological sector should be reported objectively.



SPECT scan device

A Problem

The main problem we should take into consideration in psychiatric diagnosis is that the process tend to use more subjective tools in collecting information about cases dealing with, which make it a significant problem that we can sum its negative results by the following reasons:

1. Reliability: assessments can vary a lot from a clinic to another, from psychiatric to other, depending on personal interpretations, biases, and experience, those different interpretations will lead to different conclusions “cherry-picking”¹ when evaluating same patients leading to several diagnosis, this lack of reliability undermines the validity of psychiatric diagnoses and can hinder treatment planning and research efforts.
2. Validity: subjective assessments may not capture accurately the underlying psychological processes or biological mechanism involved in a certain disorder, this lack of objective measures could lead to mislabeling or over diagnosing certain condition, leading to inappropriate treatment or unnecessary stigma for patients.
3. Treatment selection: subjective diagnoses could lead to inappropriate treatment selection, the lack of objective measures that help guide treatment decisions, some clinicians rely on trial and error method which may delay effective interventions and worsen patient outcomes.
4. Research limitations: subjective diagnosis pose challenges for psychiatric research, as they introduce variability and confounding factors that obscure findings, without standardized and reliable diagnostic criteria, studies may produce inconsistent results.

¹ cherry-picking: to select data that supports a particular view or conclusion

By returning to DSM-V

DSM-5 is considered a tool for standardizing psychiatric diagnosis that tolerates a lot of limitations and criticisms for different reasons:

- 1) Critics believe that the DSM-5's diagnostic criteria fail to sufficiently reflect latest findings in neurology, genetics, and other biological fields. There is a need for diagnostic classification systems that take into account the latest research on the biological causes of mental illness and inform individualized treatment plans.
- 2) Concerns questioning the validity and reliability of some DSM-5 diagnoses have been expressed by researchers and medical professionals. The manual mainly depends on subjective symptom reporting, which might result in inaccurate diagnosis and perhaps misleading disease labeling.
- 3) The DSM-5 is criticized for having a Western-centered bias and for possibly failing to accurately represent the manifestations and experiences of mental illness in other cultural contexts.
- 4) Critics argue that the DSM-5 has expanded the diagnostic criteria for certain disorders, leading to pathologizing normal variations in behavior. For example, the inclusion of new disorders such as Disruptive Mood Dysregulation Disorder (DMDD) and Binge Eating Disorder has raised concerns about medicalizing behaviors that may be within the range of normal human experience.

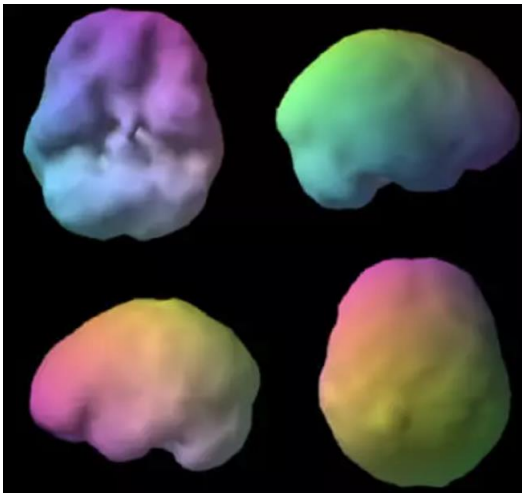
Visualizing Disorders

Everything in our surroundings has its unique form, appearance, and set of characteristics. Right as we speak, people mind instantly imagine what we are saying. Picturing is related to understanding, that's why in the case of mental illnesses, the graphic representation becomes essential. How do you oversee something immaterial? In individuals with mental disorders, SPECT imaging may indicate areas of the brain that are hyper- or hypoactive. Research has demonstrated that certain illnesses such as attention deficit hyperactivity disorder (ADHD), schizophrenia, depression, and anxiety disorders show abnormal brain activity patterns.

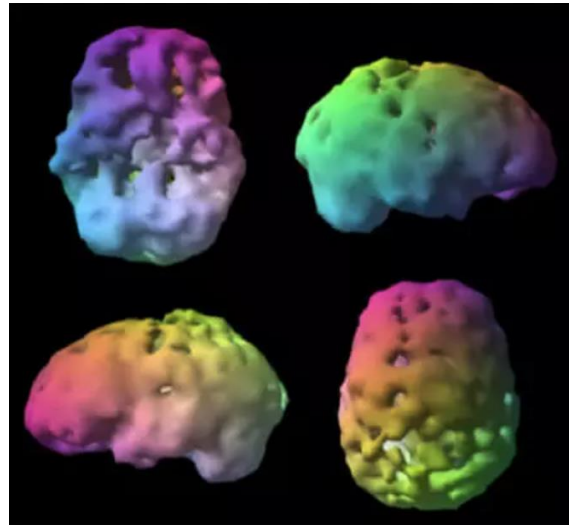
In this relation between science and subjective data, SPECT scans offer a bridge between the abstract and the concrete, allowing us to glimpse the ineffable contours of mental illness,

Moving more steps closer to comprehending the enigma of mental illness. For in the act of seeing, we find not only clarity but also understanding, recognizing that behind every mental disorder lies a story waiting to be told.

We can analyze a brain surface using a SPECT scan, by considering abnormal perfusion or metabolism that can be found in parts of the brain. To start, familiarize yourself with the basic principles of SPECT imaging and the radioactive material utilized in the scan. Analyze the pictures, noting any differences from the expected perfusion patterns and recognizing any structures that should be there. Link results with other diagnostic tests and clinical symptoms by comparing the patient's scan to reference pictures or a normal database. Systematically record the results, taking into account any possible clinical circumstances, such as tumors, ischemic stroke, neurodegenerative diseases, or mental problems. When necessary, seek advice from peers and keep abreast of developments in SPECT imaging technology and interpretation methods.



Healthy SPECT Brain surface Scan



Unhealthy SPECT Brain surface Scan

Hyper-Hypofrontality

Hyperfrontality refers to increased activity patterns or dominance of the frontal lobes of the brain, particularly the prefrontal cortex. This part of the brain is related to cognitive functions such as decision-making, planning, impulse control, and social behavior.

The term is used in the context of developmental psychology and neuroscience to describe the maturation of the prefrontal cortex. It is believed that the prefrontal cortex undergoes significant structural and functional changes during individual life, leading to improvements in executive functions and cognitive control.

Hyperfrontality is associated with improved abilities to regulate emotions, make reasoned judgments, and consider long-term consequences of actions, mature decision-making skills and social behavior.

However, hyperfrontality may lead to increased susceptibility to stress and anxiety as individuals become more aware of potential risks.

SPECT imaging can be valuable in capturing hyperfrontality and recognizing brain biomarkers and pathology, which can in turn inform psychotherapy for various disorders.

Through the use of SPECT scans, therapists can visualize hyperfrontality in conditions like obsessive-compulsive disorder (OCD), attention-deficit/hyperactivity disorder (ADHD), and addiction. This allows them to better understand the neural mechanisms underlying these disorders and modify their interventions.

On other side hypofrontality refers to decreased activity patterns of the frontal lobes, it represents a disruption in the normal functioning of this brain part, decreased prefrontal brain activity may be linked to symptoms of depression as inability to focus, apathy, and difficulty making decisions. Cognitive deficiencies in schizophrenia, such as issues with attention, working memory, and executive functioning, may be increased by hypofrontality.

Hyper-Hypo perfusion

A condition known as hyperperfusion occurs when there is an abnormally high blood flow to a certain organ or tissue inside the body, “Hyperperfusion” is the medical term for increased blood flow through an organ. The prefix “hyper” means increased or excessive, and “perfusion” refers to the passage of blood through a blood vessel (Yetman, 2022). Hyper perfusion in the brain refers to a state where there is an excessive and sometimes rapid increase in blood flow to the brain tissue. This condition can have various causes and is often associated with medical procedures or conditions that affect the blood vessels supplying the brain.

Hyperperfusion in the brain can potentially affect mental health through various mechanisms, primarily due to its impact on brain function and neurological processes. Mental Health Conditions can occur due to Excessive blood flow to some parts of the brain, hyper perfusion can cause abnormal neuronal function, which can lead to cognitive impairment. Possible signs of this include issues with memory, focus, concentration, and executive function, also Hyperperfusion may have an effect on the limbic system and prefrontal cortex², two brain areas implicated in mood regulation. In some cases, hyperperfusion can trigger or exacerbate psychiatric symptoms, particularly in individuals with underlying mental health conditions. This may include hallucinations, delusions, agitation, or psychosis. Also Hyperperfusion could affect brain function in a way that may lead to changes in behavior, including increased impulsivity, disinhibition, or emotional lability. These changes can impact decision-making and social interactions.

The degree of hyperperfusion, underlying medical disorders, individual sensitivity, and the particular brain areas impacted are some of the variables that might determine how hyperperfusion affects mental health.

² Prefrontal cortex: part of the brain, the prefrontal cortex is thought of as the “personality center” and is the cortical region that makes us uniquely human

The reverse of hyperperfusion, known as hypoperfusion, is a state in which there is a decreased blood flow to the brain. Numerous factors may contribute to this decrease in blood flow, which might result in insufficient oxygen and nutrition reaching the tissues, it can be a result of Low blood pressure, various types of shock, certain heart conditions, and Structural abnormalities of the blood vessels in the brain. Hypoperfusion in the brain can have significant effects as hyperperfusion on mental health due to its impact on brain function and neurological processes.

HOW SPECT CAN HELP?

SPECT scans can help clinicians in reaching Diagnostic Confirmation Based on measurable brain biomarkers and disease, it also can help confirm or refine a diagnosis, the scans will lead to better Treatment Planning since it will be Based on the patient's neurobiological profile and symptomatology, moreover therapists can create individualized treatment programs using the results of SPECT scans. The ability of Tracking Progress SPECT provide through various phases of therapy, can monitor alterations in brain activity, offering objective proof of treatment effectiveness and assisting with necessary modifications.

Here is an example of how SPECT can be helpful in evaluating temporal lobe³ dysfunction. J., 17, came for evaluation with extreme mood swings, suicidal and homicidal thoughts, and explosive outbursts. He had spent 18 months in a residential treatment facility at a cost of more than a \$100.000 and had been evaluated by a number of psychiatrists and multiple mental health professionals and tried on multiple medications without success. He failed residential treatment. When he was discharged he entered into a drug treatment facility for 30 days, but used drugs the day he was discharged. The drug counselor recommended a SPECT scan. His SPECT scan was severely abnormal, with a very large defect cyst occupying nearly 25% of the left prefrontal and temporal regions of his brain. Subsequently, an MRI revealed that he had a cyst the size of a tennis ball, causing a hemispheric shift and compression of ventricles.

³ Temporal lobe: part of the brain, temporal lobe is a part of your brain that helps you use your senses to understand and respond to the world around you.

His neurological exam was normal. As happened with J., most psychiatrists would diagnose him with bipolar disorder and conduct disorder, a prelude to antisocial personality disorder, and placed him on medication. When he is treatment resistant, we then wonder about his character and family environment. This all seems backwards. No amount of medication or family therapy will help this child until the pressure in his brain is relieved. Many clinicians would argue that an MRI would have been the most appropriate study in this case, and ultimately that was true. But since SPECT clearly showed this abnormality, in our opinion, it is a preferred screening tool, because it also gives information on both decreased and increased perfusion (Amen, 2010).

Brain SPECT perfusion scans are emerging as potential biomarkers for identifying and separating comorbid conditions. For example, perfusion SPECT scans were able to differentiate traumatic brain injury (TBI) and post-traumatic stress disorder (PTSD) with a sensitivity of 92% and a specificity of 85% in a study of 196 veterans. (Thornton, 2022)

SPECT perfusion scans could differentiate adults with attention-deficit hyperactivity disorder (ADHD) from normal controls with a sensitivity of 100% and a specificity of 97% in a study of over 1,000 individuals using regions of interest analysis of 3D Threshold scan data (Amen, 2021).

Limitations

The use of SPECT imaging in psychotherapy has limitations, despite the fact that it can provide insightful information about brain activity and help comprehend certain mental health conditions some of those limitations can be summarized in the next 6 points:

1. **Cost and Accessibility:** Although SPECT imaging provides insightful information, there may be substantial cost obstacles and accessibility issues. Patients in rural or underdeveloped locations may find it difficult to receive SPECT scans due to the shortage of specialist medical institutions that house the necessary equipment and knowledge. Furthermore, those without sufficient insurance or income may find this costly operation.
2. **Radiation Exposure:** SPECT imaging exposes patients to a minimal quantity of radiation due to the use of radioactive tracers. Even if the

dosage is regarded as acceptable, radiation exposure is still a worry, particularly when doing many scans over time. This might discourage some individuals from having the procedure performed, especially if they are worried about any potential risks to their health.

3. **Limited Spatial Resolution:** The spatial resolution of SPECT imaging is less than that of other imaging modalities, such as fMRI (functional magnetic resonance imaging). This implies that it could not offer detailed information on small patterns or small changes in brain activity, which might be essential to comprehending the neurological mechanisms that support psychotherapy techniques.
4. **Temporal Resolution:** Another disadvantage of SPECT imaging is its limited capacity to record the quick fluctuations in brain activity that take place during psychotherapy sessions. Psychotherapy frequently entails evolving cognitive and emotional processes throughout time, as well as dynamic exchanges between the patient and the therapist. It's possible that alternative imaging modalities can capture these dynamics more precisely than SPECT imaging.
5. **Interpretation Difficulties:** Specialized knowledge and training are needed to interpret SPECT pictures. It is possible to see alterations in brain activity patterns, but it might be difficult to interpret these changes in light of the results of psychotherapy. Linking SPECT findings to particular psychotherapy outcomes can be challenging due to several factors, including variations in brain activity, the complex nature of psychotherapeutic approaches, and the subjective character of mental health symptoms.
6. **Ethical Issues:** Using neuroimaging methods such as SPECT in psychotherapy raises some ethical questions. Concerns around informed consent, patient privacy, and the possibility of stigmatization due to imaging results are included in this. It's critical to carefully assess these ethical issues before using SPECT imaging in psychotherapy.

Overall, SPECT imaging has limits that should be carefully evaluated in the context of clinical practice and research, even if it can offer useful information about brain function and may be useful in understanding the neurological correlates of psychotherapy. It should not be viewed as a stand-alone technique for assessing psychotherapy therapies; rather, it is frequently used in conjunction with other assessment techniques.

The integration of Single Photon Emission Computed Tomography (SPECT) scans into psychotherapy assessments holds promise for revolutionizing diagnostic accuracy and treatment outcomes in mental health care. By offering a unique perspective on brain activity, SPECT imaging enables clinicians to delve deeper into the neural mechanisms underlying various psychological disorders, paving the way for more tailored and effective treatment plans. This conclusion encapsulates the key findings and implications of exploring the potential of SPECT scans in diagnosing and monitoring psychotherapy outcomes.

SPECT scans, distinct from structural imaging techniques like MRI or CT scans, focus on assessing brain function by visualizing blood flow and activity patterns. Understanding brain pathology, including structural, biochemical, and functional abnormalities, is crucial for advancing our knowledge of mental health conditions and improving treatment strategies. Biomarkers associated with brain pathology play a pivotal role in early detection, disease monitoring, treatment response assessment, and the development of personalized treatment approaches, exemplifying the significance of SPECT imaging in this context.

However, the utilization of SPECT imaging in psychotherapy is not without challenges. Limitations such as limited spatial and temporal resolution, radiation exposure, interpretation complexities, cost constraints, and ethical considerations need to be carefully addressed. Despite these challenges, SPECT imaging offers invaluable insights into brain function and can aid in confirming diagnoses, refining treatment plans, and tracking treatment progress over time.

Addressing the subjective nature of traditional diagnostic methods in psychiatry, the incorporation of objective measures like SPECT scans provides a more comprehensive understanding of mental health disorders. By visualizing hyper- and hypoactive brain regions, SPECT scans bridge the gap between subjective data and objective findings, enhancing diagnostic accuracy and treatment efficacy.

The establishment of databases like the Amen Clinics' SPECT image database further enhances the utility of SPECT imaging in psychiatry by providing a vast repository of functional brain scans for reference and research purposes. This resource facilitates objective reporting and evidence-based decision-making in psychiatric diagnosis and treatment.

Despite the limitations of SPECT imaging, it's potential to differentiate comorbid conditions and guide treatment selection is evident. From identifying structural abnormalities in traumatic brain injury to distinguishing ADHD from normal controls, SPECT imaging serves as a valuable tool in psychiatric practice.

Conclusion

While SPECT imaging offers valuable insights into brain function and pathology, its integration into psychotherapy assessments requires careful consideration of its limitations and ethical implications. By leveraging its strengths and supplementing it with other assessment techniques, clinicians can harness the full potential of SPECT imaging to optimize diagnostic accuracy, treatment outcomes, and patient care in the field of psychotherapy.

When assessing and managing mental patients, brain SPECT imaging is a useful supplementary tool. SPECT imaging has the potential to transform psychiatric practice by providing tailored diagnosis and therapy optimization because of its capacity to give objective data on brain activity. As technology advances and research continues, SPECT imaging has the potential to become a game-changing tool that helps people with mental diseases live better lives and achieve better outcomes.

Different brains react differently to different therapies, according to research, and if we could build on this understanding, we may be able to embrace a more precision-medicine strategy.

Recommendations

- Further research must be conducted to determine whether brain activity examination, such as scans, might be utilized in the clinic to customize the course of treatment.
- Work on Standardization Protocols in order to establish uniform procedures for obtaining and analyzing SPECT scans while conducting evaluations for psychotherapy. To maintain consistency and comparability across various clinical contexts, standardization imaging processes, tracer delivery, data analysis methodologies, and interpretation criteria is necessary.

- We should provide programs for mental health professionals on the use of SPECT imaging in psychotherapy evaluations, we need focus on education and training. This entails educating medical professionals on how to read SPECT scans, comprehending the constraints and possible uses of neuroimaging data, and incorporating imaging results into clinical judgments.
- Investigations into Treatment Outcomes where we carry out long-term research to assess the value of SPECT imaging in tracking treatment results and forecasting a patient's reaction to psychotherapy therapies. This may entail monitoring alterations in brain activity patterns prior to, during, and following therapy in order to find biomarkers connected to treatment response and recuperation.

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