

Why SPECT?

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What Brain SPECT Imaging *Can Tell* Clinicians and Patients
That Cannot Be Obtained Through History, Mental Status
Examinations, Physical Examinations or Neuropsychological Testing
-A review of the science by Daniel G. Amen, MD and John R. Trudeau, PhD

How Do You Know Unless You Look: The Uses and Controversies of Brain SPECT Imaging

The brain is involved in everything we do. How we think, how we feel, how we act, and how well we get along with other people is related to the moment-by-moment functioning of the brain. When the brain works right, people tend to work right. When the brain is troubled, people tend to struggle being their best selves.

If we agree that mental disorders and difficult behaviors may be related to functional problems in the brain, and that brain SPECT imaging is a reliable measure of regional cerebral blood flow and thus activity patterns (1), then it follows that we should take advantage of this powerful tool when faced with complex situations or with patients unresponsive to treatment? How can we fully evaluate the cause for mental illness unless we look at brain function -- otherwise we are left to deduce or guess or assume what may be going on in the brain

For physicians:

1. A SPECT scan shows the underlying cerebral blood flow and consequently metabolic activity patterns of the brain. A scan can show:
 - a. specific areas of the brain that are implicated with specific problems, such as the prefrontal cortex with executive function and the medial temporal lobes with getting information into long term storage.
 - b. unexpected findings that may be contributing to the problem(s), such as toxicity, potential areas of seizure activity, or past brain trauma (extensive clinical experience).
 - c. underlying potential seizure activity that may be contributing to the problem, more accurately seen by SPECT than standard EEG, especially in the areas of the medial temporal lobe (over 41 studies with > 1300 patients on SPECT and epilepsy -- see www.brainplace.com for references).
 - d. specific target areas for treatment, such as an overactive basal ganglia, anterior cingulate gyrus (seen on anxiety and OCD spectrum disorders) or

an under active temporal lobe (seen in seizure disorders and other disorders such as trauma).

- e. the specific effect of medication on the brain and subsequently how to adjust dosages. Often patients report that SSRIs are helpful but also cause demotivation or memory problems. SPECT studies can show when SSRIs are causing excessive decreased prefrontal or temporal lobe activity that clinical evaluation only hints at.
- f. how the brain functions on treatment (improved or worsened). You can see many before and after scans at www.brainplace.com.

2. In some respects, brain SPECT imaging is superior to other imaging technologies for the study of brain function related to mental illness and aberrant behaviors. As opposed to PET or fMRI, a SPECT scan's image occurs while the patient is sitting upright in an injection room, not when he or she is lying in the camera. Within 2 minutes of injecting the radiopharmaceutical for SPECT it locks in the brain where it stays fixed and measurable for 6 hours.

The SPECT image occurs in a more normal mind-state (in the injection room), rather than while a person is in a PET scanning device or lying in an MRI tube listening to what sounds like machine gun fire - MRI tubes are noisy and can be frightening. PET requires 30 to 45 minutes to form an image of brain activity, whereas in SPECT the radioisotope is fully distributed within 2 or 3 minutes of injection.

Because the image occurs at the time of injection outside the imaging camera, it gives SPECT several significant advantages. Most notably, we are able to sedate people after they have been injected so that they can lie still for the scan and not affect the images. Often hyperactive or autistic children or demented adults have difficulty lying still for the scan, which is essential for a high quality scan (motion artifact ruins the scan in all of these imaging techniques).

3. A SPECT scan helps provide real, demonstrable answers to refractory symptoms and, in addition, helps clinicians ask better and more targeted questions - about toxic exposure, brain injuries, anoxia, inflammation, or infection, that patients may have initially denied or forgotten.

4. A SPECT scan helps clinicians prevent mistakes or hurting patients by prescribing the wrong treatments, such as unnecessarily stimulating an already overactive brain or calming an under active one.

5. A SPECT scan can help to evaluate those who may be at risk for dementia - the brain starts to change long before people show symptoms of dementia. One study reported that there has to be a loss of 30% in the hippocampus before symptoms occur. Using autopsy data in 54 patients Bonte (2) reported that brain SPECT had a positive predictive value for Alzheimer's disease of 92%.

6. SPECT scans can also help to differentiate between types of dementia (Alzheimer's disease, frontal temporal lobe dementia, Lewy body dementia, multi-infarct dementia early in the disease have their own patterns) (over 83 studies with >4500 patients -- see www.brainplace.com for references).

7. SPECT scans help clinicians understand why they use certain medications such as anticonvulsants to stabilize temporal lobe function or calm focal areas of marked hyperactivity, or stimulants to enhance decreased prefrontal perfusion or SSRIs to calm basal ganglia and anterior cingulate hyperactivity.

8. A SPECT scan can identify specific areas of the brain hurt by trauma (over 38 studies with >1300 patients -- see www.brainplace.com for references) to better target treatment and help deal with insurance, legal and rehabilitation issues.

9. A SPECT scan can often identify a specific cause or reason that contributes to recovering alcoholics, drug addicts, eating disordered, or sexual addicts relapse behavior in their recovery from an addictive process. For example: the patient may have suffered an injury in the prefrontal cortex or temporal lobes or have overactivity in basal ganglia, limbic system, or prefrontal cortex, each of which could contribute to the relapsing behaviors.

10. A SPECT scan is also useful to determine if further adjustment of medication is needed. SPECT scans on medication will reveal areas of the brain that need to be further addressed for overactivity or under activity.

For patients:

- a. A SPECT scan allows patients to have a specific physical representation of their problems that is accurate and reliable.
- b. A SPECT scan helps develop a deeper understanding of the problem and leads to decreased shame, guilt, stigma and self-loathing. They can increase self-forgiveness. Patients can see that their problems are, in part, a medical problem.
- c. A SPECT scan helps to increase compliance - pictures are powerful. These are very powerful influences in determining a patient's willingness and ability to accept and adhere to a treatment program -- as they realize that not taking medication for their problems of anxiety, depression, rage, ADD, etc. is similar to not wearing the "right" prescription for their eyes.
- d. A SPECT scan helps families understand when things will not get better, such as having permanent brain damage from an injury, this allows patients and families to accept the condition and provide accordingly.
- e. A SPECT scan helps substance abusers decrease denial and be motivated for treatment by seeing the damage they have done to their own specific brain. A SPECT scan can help motivate recovering alcoholics and addicts continue in sobriety as it becomes clear to patients that further use will cause increased brain scalloping and further damage.

- f. A SPECT scan physically shows patients how treatments have impacted (improved or worsened) brain function.
- g. A SPECT scan helps motivate verbally and physically abusive spouses to follow medication protocols by seeing they have a physical abnormality that may be contributing to their problems.
- h. A SPECT scan is useful for the patient that is post chemotherapy and is suffering with "a chemotherapy toxic brain." It gives them insight into their cognitive struggles and also helps their doctors see what is physical and what might be emotional or traumatic sequelae of having cancer.
- i. A SPECT scan allows patients to understand why specific treatments are indicated, which medications are helpful, and why certain medical interventions are chosen.

We use SPECT in a clinical environment to observe patterns of activity, to guide us in re-balancing a brain whose activity patterns are clearly abnormal. A SPECT scan can guide us in the application of specific medications or other treatments such as supplements, neurofeedback, transcranial magnetic stimulation, and hyperbaric oxygen therapy.

SPECT is never the complete or final answer. It is part of the answer that when used with a good clinical history and examination gives clinicians and patients more information for diagnosis and to tailor treatments to the specific patient.

What SPECT Scans Cannot Do:

- Give a diagnosis in the absence of clinical information
- Assess or evaluate IQ
- Assess or evaluate the guilt, innocence, motivation or sanity of a criminal defendant

Cautions About SPECT:

- Variability of technique issues:
 - Processing protocols need to be standardized and optimized
 - Motion can ruin a scan, so NO MOTION
 - Need to know how to identify and deal with artifact
- Variability of cameras:
 - Multi-headed cameras are clearly superior, as they can scan much faster. It takes an hour to do a scan on a single headed camera, 30 minutes on a dual headed camera and 15 minutes on a triple headed camera.

Experience of readers (we have read more than 40,000 scans to date):

Need documented high inter- and intra-rater reliability. Scans with CorePsych include Amen Clinic readings and review.

Image Display:

Scans must be clear, understandable, and easily illustrative of brain function, and available to the patient on a timely basis.

Common Concerns and Responses:

-Concern: Low Resolution (it is commonly said that a SPECT scan is a "poor man's PET study")

Response: With multi-headed cameras SPECT is in the same resolution as PET (3) with considerably lower cost, a greater possibility of insurance coverage, and greater availability, as well as less artifact and it is an easier procedure to do.

-Concern: Radiation exposure, especially in children

Response: The average radiation exposure for one SPECT scan is 0.7rem (i.e., similar to a nuclear bone scan or brain CAT scan) and is a safe procedure according to the guidelines established by the American Academy of Neurology (4). The latter procedures are routinely ordered for many common medical conditions (i.e., bone fractures or head trauma), further suggesting that these levels of radiation exposure are generally acceptable in medical practice when indicated. An important consideration: ineffectively treated psychiatric illness has many more risks than the limited risk associated with low levels of radiation associated with a SPECT scan.

-Concern: The perceived lack of normals

Response: In the SPECT literature of the past 20 years there have been more than 43 studies that look at normative issues in over 2450 patients, including 150 children from birth on (see www.brainplace.com for references). These numbers do not include thousands of control subjects used in studies of specific neurological and psychiatric conditions. For example, Chiron et. al. (5) reported that at birth, cortical regional cerebral blood flow (rCBF) was lower than those for adults; after birth they increased until 5 or 6 years of age to values 50%-85% higher than those for adults and thereafter decreased, reaching adult levels between 15 and 19 years. At the age of 3, however, they had the same relative blood flow patterns as adults. Other common findings in normal studies suggest that women have generally higher perfusion than men and age, drug abuse, and smoking have a negative effect on rCBF.

-Concern: Some physicians say, "I don't need a scan for diagnosis, I can tell clinically"

Response: often, well-trained physicians can tell clinically. But that is not when you order a SPECT scan. You order scans when you are confused or the picture is complicated.

-Concern: Lack of reproducibility

Response: The paper by Villanueva-Meyer, Javier M.D et al "Cerebral blood flow during a mental activation task: responses in normal subjects and in early Alzheimer disease patients" (6) elegantly answers this question showing that there is less than 3% variability in SPECT scans over time for the same activity. Our own clinical experience, scanning people sequentially, and sometimes 12 years apart, is that SPECT patterns are the same unless you do something to change the brain. SPECT is a reproducible and reliable method for sequential evaluation.

References

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