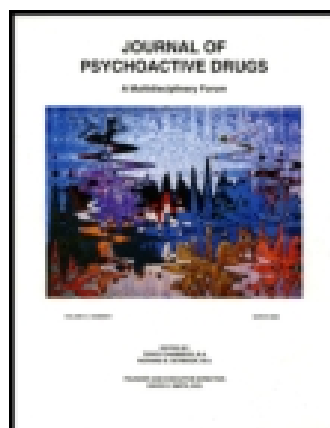


This article was downloaded by: [Johns Hopkins University]

On: 08 January 2015, At: 13:32

Publisher: Routledge

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



## Journal of Psychoactive Drugs

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/ujpd20>

### The Clinical Utility of Brain SPECT Imaging in Process Addictions

Daniel G. Amen M.D.<sup>a</sup>, Kristen Willeumier Ph.D.<sup>a</sup> & Robert Johnson D.O.<sup>b</sup>

<sup>a</sup> Amen Clinics, Inc., Newport Beach, CA, USA

<sup>b</sup> Sierra Tucson, Tucson, AZ, USA

Published online: 07 Mar 2012.

To cite this article: Daniel G. Amen M.D., Kristen Willeumier Ph.D. & Robert Johnson D.O. (2012) The Clinical Utility of Brain SPECT Imaging in Process Addictions, Journal of Psychoactive Drugs, 44:1, 18-26, DOI: [10.1080/02791072.2012.660101](https://doi.org/10.1080/02791072.2012.660101)

To link to this article: <http://dx.doi.org/10.1080/02791072.2012.660101>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

# The Clinical Utility of Brain SPECT Imaging in Process Addictions

Daniel G. Amen, M.D.<sup>a</sup>; Kristen Willeumier, Ph.D.<sup>b</sup> & Robert Johnson, D.O.<sup>c</sup>

**Abstract**— Brain SPECT imaging is a nuclear medicine study that uses isotopes bound to neurospecific pharmaceuticals to evaluate regional cerebral blood flow (rCBF) and indirectly metabolic activity. With current available technology and knowledge SPECT has the potential to add important clinical information to benefit patient care in many different areas of a substance abuse practice, including in the area of process addictions. This article explores the ways brain SPECT has the potential to be useful to clinicians in helping to understand and direct treatment for complex cases of obesity and sexual addictions. Areas where SPECT can add value include helping clinicians ask better questions, helping them in making more complete diagnoses, evaluating underlying brain systems pathology, decreasing stigma and increasing compliance, and visualizing effectiveness via follow-up evaluations. In particular, SPECT can help in identifying and assessing the issue of brain trauma and toxicity in process addictions, which may be significant contributing factors in treatment failure. Three illustrative case histories will be given.

**Keywords**— brain injuries, brain SPECT, neuroimaging, obesity, process addictions, sexual addiction, toxicity

Brain SPECT imaging is a nuclear medicine study that uses isotopes bound to neurospecific pharmaceuticals to evaluate regional cerebral blood flow (rCBF) and indirectly metabolic activity. With current available technology and knowledge SPECT has the potential to add important clinical information to benefit patient care in many different areas of an addiction medicine practice, including in the area of process addictions. This article explores the ways in which brain SPECT has the potential to be useful to clinicians in helping to understand and direct treatment for complex cases of chemical and behavioral addictions, including sexual compulsivity, overeating, self-harm, purging, gambling, compulsive video-game playing, and compulsive spending/shopping. Four cases studies

illustrating the potential usefulness of SPECT in process addictions will be given.

The American Society of Addiction Medicine's definition of addiction (ASAM 2011) states there are multiple areas of the brain involved in addiction to food, sex and alcohol and other drugs, such as the frontal cortex, anterior cingulate gyrus, nucleus accumbens, amygdala and hippocampus. Yet, even though it is clear that the brain is the organ of behavior, addiction clinicians rarely utilize available brain imaging tools to help with diagnosis and treatment. Instead, they rely on clinical histories, symptom clusters, self-rating questionnaires and mental status examinations.

Brain single photon emission computed tomography (SPECT) is in a unique position to be helpful in understanding the individual pathophysiology of patients suffering from addictions. Areas where SPECT can add value include: helping clinicians ask better questions, making more complete diagnoses, evaluating underlying brain systems pathology, decreasing stigma, increasing compliance, and visualizing the effectiveness of treatment via follow-up

<sup>a</sup>CEO and Medical Director, Amen Clinics, Inc., Newport Beach, CA.

<sup>b</sup>Director of Research, Amen Clinics, Inc. Newport Beach, CA.

<sup>c</sup>Medical Director, Sierra Tucson, Tucson, AZ.

Please address correspondence to Daniel G. Amen, M.D., Amen Clinics Inc., 4019 Westerly Place, Suite 100, Newport Beach, CA 92660; email: docamen@amenclinics.com

scans. Of particular note, SPECT can help identify and assess the issues of brain trauma and toxicity, which may be significant contributing factors in cases of treatment failure. In this article we will review potential uses of SPECT in an addiction practice, particularly as it relates to food and sex addiction.

## STANDARD BRAIN SPECT INDICATIONS

SPECT's prolific use in peer-reviewed research validates that it is a well-established and reliable measure of brain function (regional cerebral blood flow, or rCBF). Both the American College of Radiology (ACR 2007) and the European Society of Nuclear Medicine (ESNM) (Kapucu et al. 2009) have published similar evidenced-based medicine (EBM) guidelines for using SPECT in patient care. The commonly accepted clinical indications for SPECT include:

- Evaluating patients for cerebrovascular disease.
- Evaluating patients with suspected dementia including early detection, differential diagnosis, and in the predementia phase, known as mild cognitive impairment, SPECT can detect functional deficits and thus guide prognosis.
- Localizing epileptic foci.
- Evaluation of traumatic brain injury especially in the absence of computed tomography (CT) and/or magnetic resonance imaging (MRI) findings. SPECT has shown perfusion abnormalities in traumatic brain injury despite normal morphology, and results are considered to have a prognostic value.
- Evaluation of suspected inflammation to provide helpful information in progressive inflammatory disorders including viral encephalitis, vasculitis, and HIV-encephalopathy.
- Assessing brain death.

All of these indications, except assessing brain death, are potential contributing factors in addiction medicine. Besides the common indications, the ESNM guidelines also state, "SPECT can be useful in other indications such as . . . psychiatric diseases (e.g. for follow-up of depression)," which is common in patients with addictive disorders, including process addictions. Camargo (2001) wrote:

Brain SPECT, in particular, with perfusion agents or with neuroreceptor imaging radiopharmaceuticals, is rapidly becoming a clinical tool in many places. The importance of this technique in nuclear medicine today should not be overlooked, particularly in cerebrovascular diseases, dementias, epilepsy, head injury, malignant brain tumors, movement disorders, obsessive-compulsive disorder, Gilles de la Tourette's syndrome, schizophrenia, depression, panic disorder, and drug abuse.

In experienced hands, brain SPECT imaging provides clinically useful information on how an individual's brain

functions. It allows a more complete diagnostic picture, adding biological information about the presenting problem, and often helps to direct treatment, such as showing the need to enhance low perfusion areas of the brain or to calm hyperactive ones.

## FIVE WAYS SPECT HAS THE POTENTIAL TO BE HELPFUL IN PROCESS ADDICTIONS

### 1. SPECT has the Potential to Help Clinicians Ask Better Questions

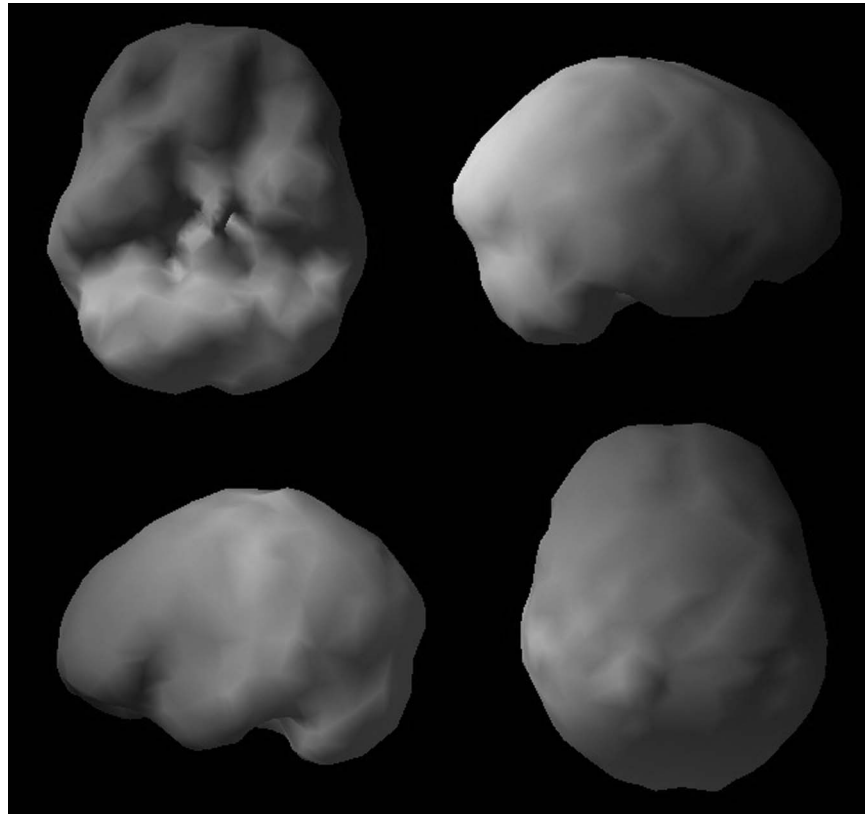
Harold Bursztajn, M.D., cofounder of the Psychiatry and Law Program at Harvard, says that SPECT scans do not give you the answer, they teach you to ask better questions (Bursztajn 2002). The results from a scan do not give a diagnosis per se; they are involved in the investigation of the problem. For example, if a brain injury pattern is seen but not given by history it informs the clinician to ask more pointed questions about brain injury, or if a toxic pattern is noticed it guides the clinician to explore further for any possibilities for toxicity. Neuroimaging will never map directly over to DSM diagnostic categories, because they are based on historical symptom clusters, rather than on the identification and treatment of specific, dysregulated neurophysiologic pathways that have multiple etiologies and multiple subtypes. That is why there will never be, for example, a signature SPECT image for depression.

**Case 1.** B, age 35 and a married firefighter, had failed several attempts at treatment for sexual addiction, including an inpatient treatment program. On the verge of divorce, he was referred for a brain SPECT study to gather more information. Compared to a healthy scan (Figure 1) his scan showed overall severe low perfusion (Figure 2) in a "diffuse encephalopathic" pattern often seen with some form of toxicity, such as those produced by drugs, alcohol or an environmental toxin. Several years before, B had been involved in several intense firefighting and had experienced a smoke inhalation injury. This finding is consistent with published literature on SPECT and carbon monoxide poisoning (Choi et al. 1995). Intense brain rehabilitation was then started as part of B's treatment program. This information was helpful to the patient, his wife and his physician.

### 2. SPECT has the Potential to Help Clinicians Give More Complete Diagnoses and Not Miss Important Clinical Information

Without imaging data clinicians may miss important pieces of biological information, such as brain injuries, toxic exposure, early dementia vulnerability, and potential seizure activity. Scans also show if there is hyperfrontality, hypofrontality or significant asymmetries in function. SPECT also helps physicians not miss anatomical lesions that may be contributing to the problems. We feel that starting with a SPECT scan is more practical than starting with

**FIGURE 1**  
**Healthy Brain SPECT Study; Surface View**



Full, even, symmetrical perfusion. The surface view looks at the top 45% of brain perfusion.

CT scans or MRIs because functional data is also obtained. Here is an example.

**Case 2.** J, age 43, had been in treatment for sex addiction on five different occasions. He had also been diagnosed with ADHD and mixed personality disorder with narcissistic and antisocial features. His treating physician referred him for a SPECT scan for more diagnostic information. Compared to a healthy SPECT scan, J's scan (Figure 3) showed low activity in the inferior orbital prefrontal cortex, an area of the brain involved with impulse control. In addition, there was asymmetrical low perfusion in the left superior prefrontal cortex and bilaterally in both temporal lobes, more severe on the left side. The low perfusion more lateralized to the left hemisphere is often seen in a traumatic brain injury pattern. Even though the patient initially denied any history of brain injury, on further detailed questioning he remembered being knocked unconscious as a ten-year-old child from being hit in the head with a baseball. The information on the past brain injury plus the location of the injury helped J understand why he

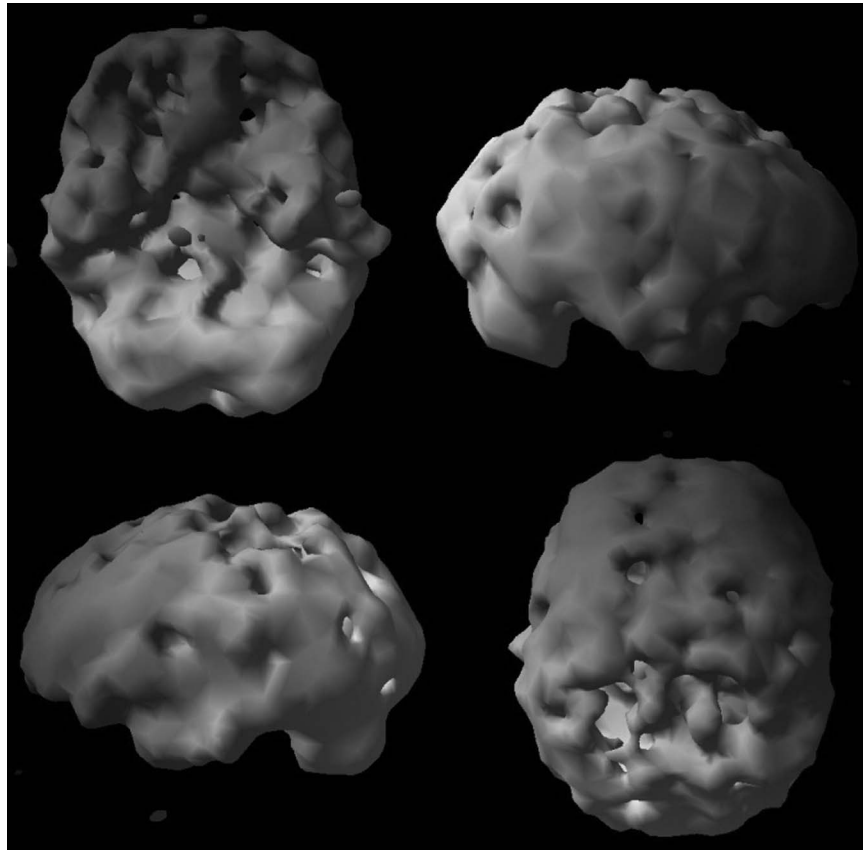
was having trouble maintaining his sobriety and led to more specific brain injury treatments, including hyperbaric oxygen therapy, which has been shown to be helpful for rehabilitating brain injuries (Harch et al. 2011).

### 3. SPECT has the Potential to Help Subtype Addictions in Individual Patients

The use of functional neuroimaging in clinical practice dovetails closely with the spirit of the new Research Domain Criteria (RDoC) initiative from the National Institute of Mental Health, which looks to develop new ways of classifying psychopathology based on observable behavior and neurobiological measures (NIMH 2010). Subtyping illnesses, such as process addictions, based on the clinical picture plus brain system pathology will be essential to finding appropriate treatments for individual patients.

Based on the brain SPECT work at the Amen Clinics we have found that there are different types of anxiety and depression (Amen & Routh 2004), ADHD (Amen

**FIGURE 2**  
**Patient B with Sex Addiction; Brain SPECT Surface View**



Overall low perfusion and scalloping, which is indicative of a pattern of diffuse encephalopathy, in this case likely from toxic exposure.

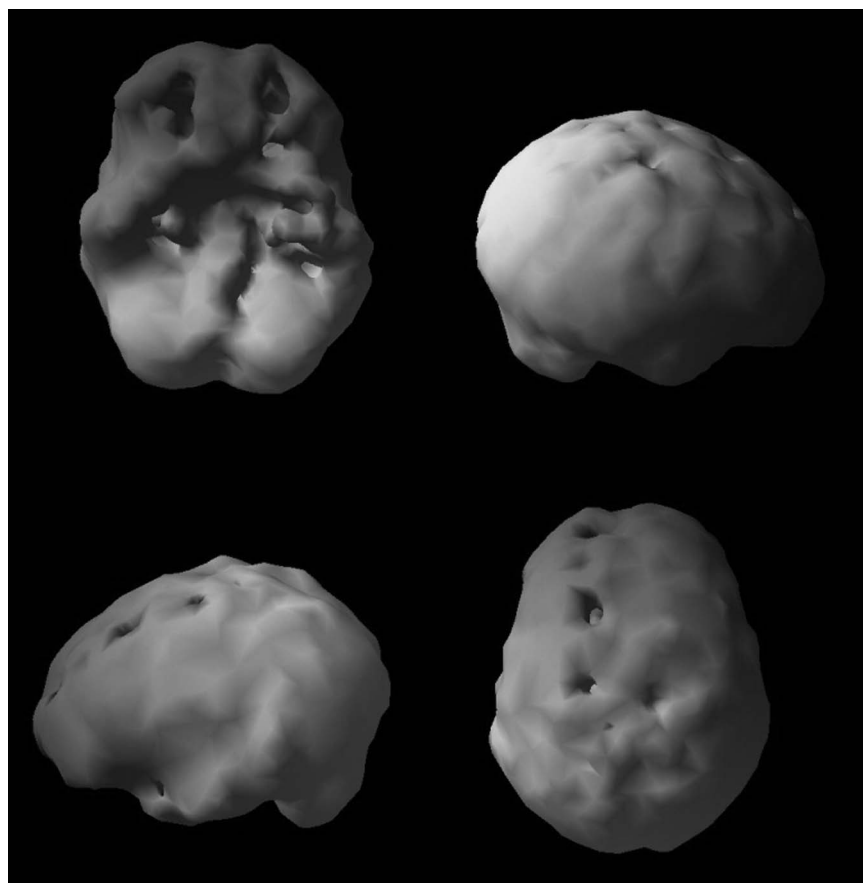
2002), and addictions (Amen & Smith 2010), including over-eating disorder. In the case of people who struggle with food addiction we have seen at least five different brain SPECT patterns: compulsive, impulsive, impulsive-compulsive, sad, and anxious (Amen 2011). Giving every addict the same treatment plan invites failure and frustration. For example, some addicts struggle with compulsivity, commonly associated with hyperfrontality (Lacerda et al. 2003), some struggle with impulsivity, associated with low prefrontal cortex activity (Goethals et al. 2005), and others struggle with both impulsivity and compulsivity. Knowing the individual brain circuits involved helps clinicians tailor the treatment more effectively. Hyperfrontality is more likely to respond to serotonergic interventions (Diler et al. 2004), while hypofrontality is more likely to respond to stimulant medications (Amen, Hanks & Prunella 2008), and patients who are both impulsive and compulsive may need both types of intervention. The impulsive-compulsive group in our experience is the most common type of addict,

and for weight issues was the group most likely to respond to the fen-fen diet, which was a combination of a serotonergic intervention (fenfluramine) and a dopaminergic intervention (phentermine). We postulate that some sad and anxious addicts self-medicate underlying psychiatric disorders by their choice of addiction, such as using simple carbohydrates to raise serotonin levels to help with feelings of depression or anxiety.

#### **4. SPECT has the Potential to Motivate, Decrease Stigma and Increase Compliance**

A SPECT scan helps patients develop a deeper understanding of their problems, see their problems from a medical point of view, and dramatically decrease shame, guilt, stigma and self-loathing. Scans also help increase self-forgiveness, and the forgiveness and understanding of others. Patients can see that their problems are, in part, a medical problem and not simply “willfulness run riot.” SPECT scans are also powerful for families, and help to

**FIGURE 3**  
**Patient J with Sex Addiction; Brain SPECT Surface View**



Low perfusion noted in inferior orbital prefrontal cortex, left superior prefrontal cortex and both temporal lobes, more severe on the left.

mobilize them in a similar way as when medical illnesses, such as cancer or heart disease, are present. There is nothing else in psychiatry that results in such an immediate and strong intervention to decrease stigma.

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 care of their brain or treating underlying illnesses is similar to not wearing the right prescription for their eyes.

**Case 3.** F, a 57-year old self-employed businessman who was married for the third time, was admitted to the hospital for depression, substance abuse, PTSD, and sexual compulsivity. The admission was initially triggered by his wife's request for a divorce after he and his wife were served with child support papers in their driveway as they were about to leave for a vacation, related to a six-year-old

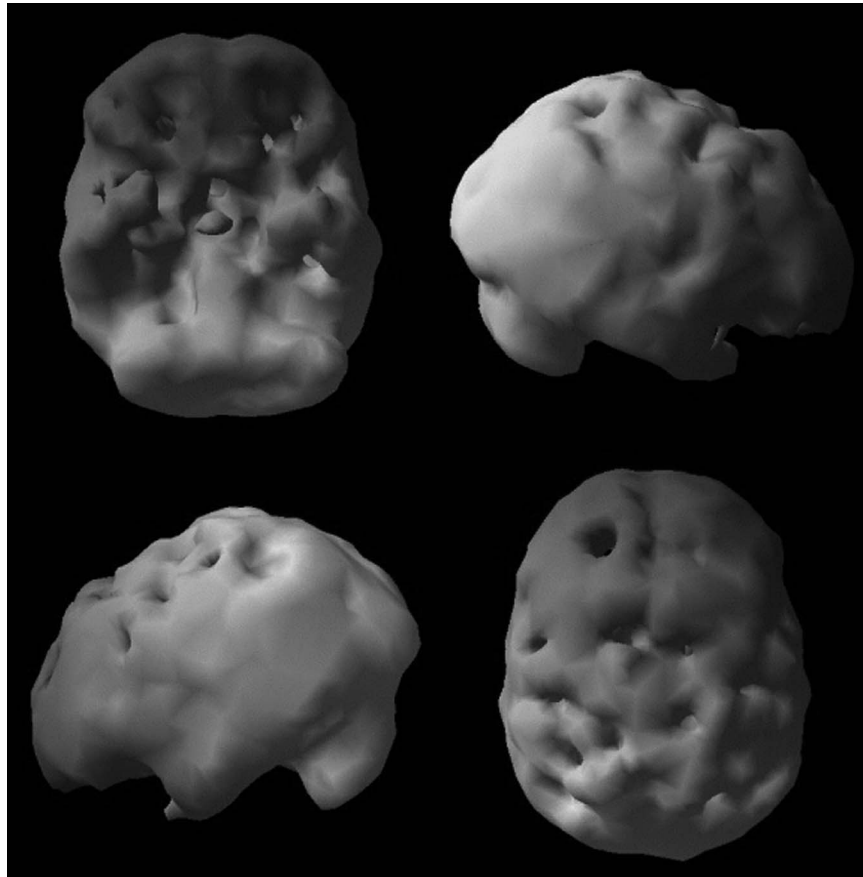
son from a prior affair that the patient had not divulged to his wife.

On admission the patient stated, "I am a failed man within my family. I love my wife. I just don't know what's wrong with me . . . how come I continue to engage in this behavior?" A prior psychiatric hospitalization for sex addiction, regular church involvement, and ongoing immersion in a 12-Step program had not enabled him to maintain sexual sobriety.

F had a past history of cocaine abuse and a bipolar Type II mood cycling pattern consisting of hypomania and depression, in addition to atypical four-day cycles of mild depression that triggered escalating levels of anxiety/panic, vomiting, psychosocial withdrawal/isolation, and dissociation. These latter cycles began four years prior, a week after his current wife left him for the first time in response to the discovery of an adulterous affair, and a day after he discovered an employee who had been murdered in his



**FIGURE 4**  
**Patient F with Brain Trauma, ADHD and Toxic Exposure; Brain SPECT Surface View**



Decreased activity in the left and right parietal, occipital, and temporal lobes (consistent with a past brain trauma), decreased left and right inferior orbital prefrontal cortex activity (consistent with ADHD), and moderate scalloping (consistent with past substance abuse). The low prefrontal cortex activity is often associated with a broken “brake,” leaving trouble with impulse control. The low temporal lobe activity is often associated with mood instability.

office. This cycle of PTSD-related emotional activation, autonomic reactivity, and dissociation would also recur after each bout of sex outside of his marriage, which most often occurred during periods of hypomania. This patient also had a history of “mild” sports-related traumatic brain injuries and ADHD.

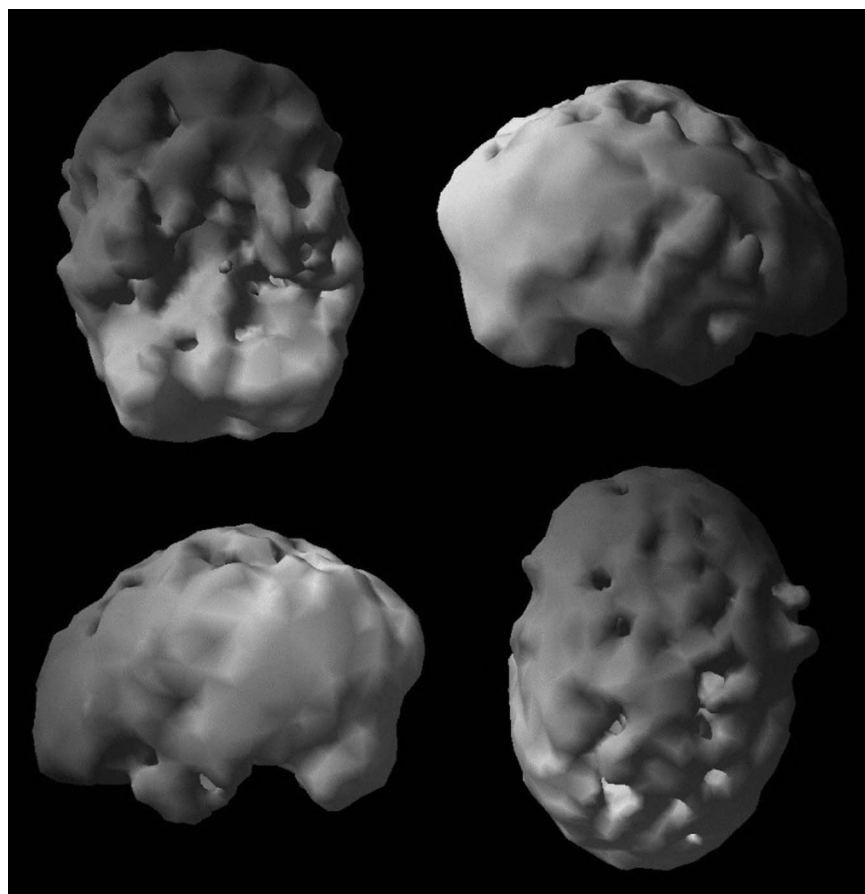
As part of a comprehensive assessment a brain SPECT study was performed (Figure 4), which showed decreased activity in the left and right parietal, occipital, and temporal lobes (consistent with past brain trauma), decreased left and right inferior orbital prefrontal cortex activity (consistent with ADHD, brain trauma, and/or substance abuse), and moderate scalloping (consistent with past cocaine abuse). The low temporal lobe activity is often associated with mood instability. A primary role of the prefrontal cortex is to enable intention to guide behavior; as a result,

low prefrontal cortex activity is often reflective of a broken frontal lobe “brake” or “filter,” resulting in persistent struggles with impulse control, even in highly motivated individuals.

Putting these SPECT findings and the patient’s clinical history together, the combination of hypomanic cycling with a broken frontal lobe filter from traumatic brain injuries, ADHD, and toxicity from prior cocaine abuse creates a perfect recipe for the perpetuation of a very vexing and persistent process addiction.

The scan images were very helpful for the patient and his wife; during his SPECT feedback session, the patient began to weep, and stated, “I can’t tell you how powerful this is for me . . . as strange as it sounds, it’s a *relief* to see that at least a part of this is related to how my brain functions. I know it’s not a get-out-of-jail-free

**FIGURE 5**  
**Patient A—Before Image; Brain SPECT Surface View**



Low overall perfusion

card, but I've never understood how I've been able to be successful in so many other areas of my life, but have not been able to control this addiction, or my response to traumatic events—even the trauma of betraying my own core values." This realization helped to shift the dialogue from willfulness, lack of self-discipline, and shame to the physiologic effects on the brain of physical and psychological trauma, ADHD, and substance abuse.

#### **5. SPECT has the Potential to Visualize How Effective Treatments are Working Through Follow-Up Scans**

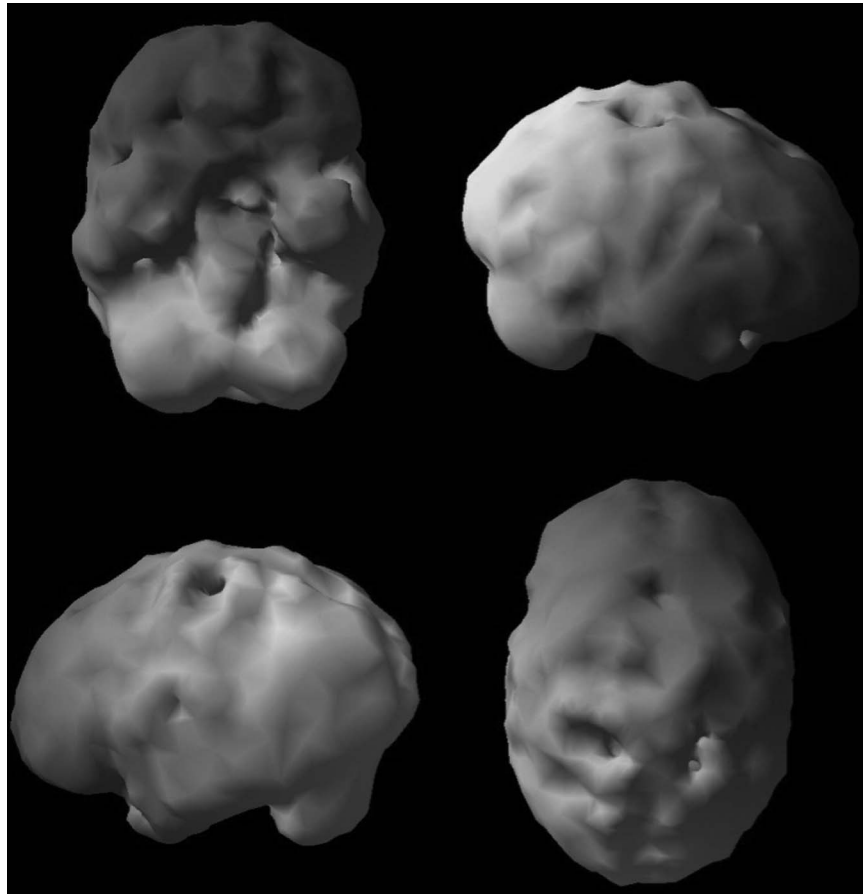
Follow-up scans can provide evidence of a treatment's effectiveness or ineffectiveness for both clinicians and patients. Once a plastic surgeon does a procedure he and the patient can visualize the outcome and see a positive or negative effect of the work. SPECT provides a similar

opportunity. Follow-up scans also make clinicians more responsible. When a follow-up scan shows the patient's brain is worse, rather than blame the patient, clinicians can redesign the plan.

**Case 4.** A, a 53-year-old male, was concerned about brain health and came for an evaluation, including brain SPECT. His scan showed severe overall low activity (Figure 5). He admitted to drinking three to four alcoholic drinks a day, but reported he was never drunk and it did not cause any problems for him. He was also 100 pounds overweight. When A saw his scan and learned that as a person's weight goes up, the actual size and function of the brain goes down (Willeumier et al. 2011; Raji et al. 2010), it motivated him to get healthy. He stopped drinking alcohol and lost 100 pounds. Eleven years later he came back for a follow-up SPECT scan to see his progress, which was dramatic, both in terms of his brain health (Figure 6) and overall physical health.



**FIGURE 6**  
**Patient A—After Image; Brain SPECT Surface View**



Marked overall increase in perfusion

## CONCLUSION

There is a converging body of literature and clinical experience on the usefulness of brain SPECT imaging in a number of areas relevant to addiction medicine. Some authors have written that it is unethical to order scans when there is not yet enough consensus or research on the clinical use of imaging (Bush 2008). We believe that it is not

only unethical to withhold potentially valuable information from clinicians, patients and families, it also hurts the medical profession and society at large. Still, there is much work to do to bring widespread use of brain imaging into clinical practice for substance abuse practitioners. The next two decades will see a radical shift in the way substance abuse treatment and psychiatry is practiced, and imaging will play an important role in the change.

## REFERENCES

- Amen, D.G. 2011. *The Amen Solution: The Secrets to Being Thinner, Smarter and Happier*. New York: Crown Archetype.
- Amen, D.G. 2002. *Healing ADD: The Breakthrough Program That Allows You to See and Heal the 6 Types of ADD*. New York: Putnam.
- Amen, D.G. & Smith, D.E. 2010. *Unchain Your Brain: 10 Steps to Breaking the Addictions That Steal Your Life*. Newport Beach, CA: Mindworks.
- Amen, D.G. & Routh, L.C. 2004. *Healing Anxiety and Depression*. New York: Putnam.
- Amen, D.G.; Hanks, C. & Prunella, J. 2008. Predicting positive and negative treatment responses to stimulants with brain SPECT imaging. *Journal of Psychoactive Drugs* 40 (2): 131–38.
- American College of Radiology (ACR). 2007. *American College of Radiology Practice Guidelines for the Performance of Single*

- Photon Emission Computed Tomography (SPECT) Brain Perfusion and Brain Death Studies*. Available at: [http://www.acr.org/SecondaryMainMenuCategories/quality\\_safety/guidelines/toc.aspx](http://www.acr.org/SecondaryMainMenuCategories/quality_safety/guidelines/toc.aspx).
- American Society of Addiction Medicine (ASAM). 2011. *Definition of Addiction*. Available at: <http://www.asam.org/for-the-public/definition-of-addiction>
- Bursztajn, H.J. 2002. Personal communication.
- Bush, G. 2008. Neuroimaging of attention deficit hyperactivity disorder: Can new imaging findings be integrated in clinical practice? *Child and Adolescent Psychiatric Clinics of North America* 17 (2): 385–404.
- Camargo, E.E. 2001. Brain SPECT in neurology and psychiatry. *Journal of Nuclear Medicine* 42 (4): 611–63.
- Choi, I.S.; Kim, S.K.; Lee, S.S. & Choi, Y.C. 1995. Evaluation of outcome of delayed neurologic sequelae after carbon monoxide poisoning by technetium-99m hexamethylpropylene amine oxime brain single photon emission computed tomography. *European Neurology* 35 (3): 137–42.
- Diler, R.S.; Kibar, M. & Avci, A. 2004. Pharmacotherapy and regional cerebral blood flow in children with obsessive compulsive disorder. *Yonsei Medical Journal* 45 (1): 90–99.
- Goethals, I.; Audenaert, K.; Jacobs, F.; Van den Eynde, F.; Bernagie, K.; Kolindou, A.; Vervae, M.; Dierckx, R. & Van Heeringen, C. 2005. Brain perfusion SPECT in impulsivity-related personality disorders. *Behavioral Brain Research* 157 (1): 187–92.
- Harch, P.G.; Andrews, S.R.; Fogarty, E.F.; Amen, D.; Pezzullo, J.C.; Lucarini, J.; Aubrey, C.; Taylor, D.V.; Staab, P.K. & Van Meter, K.W. 2011. A phase I study of low-pressure hyperbaric oxygen therapy for blast-induced post-concussion syndrome and post-traumatic stress disorder. *Journal of Neurotrauma*. [Epub ahead of print].
- Kapucu, O.L.; Nobili, F.; Varrone, A.; Booi, J.; Vander Borgh, T.; Nagren, K.; Darcourt, J.; Tatsch, K. & Van Laere, K.J. 2009. EANM procedure guideline for brain perfusion SPECT using 99mTc-labelled radiopharmaceuticals, version 2. *European Journal of Nuclear Medicine and Molecular Imaging* 36 (12): 2093–2102.
- Lacerda, A.L.; Dalgarrondo, P.; Caetano, D.; Camargo, E.E.; Etchebehere, E.C. & Soares, J.C. 2003. Elevated thalamic and prefrontal regional cerebral blood flow in obsessive-compulsive disorder: a SPECT study. *Psychiatry Research* 123 (2): 125–34.
- National Institute of Mental Health (NIMH). 2010. *Genes and Circuitry, Not Just Clinical Observation, to Guide Classification for Research*. Available at: <http://www.nimh.nih.gov/science-news/2010/genes-and-circuitry-not-just-clinical-observation-to-guide-classification-for-research.shtml>.
- Raji, C.A.; Ho, A.J.; Parikshak, N.N.; Becker, J.T.; Lopez, O.L.; Kuller, L.H.; Hua, X.; Leow, A. D.; Toga, A.W. & Thompson, P.M. 2010. Brain structure and obesity. *Human Brain Mapping* 31 (3): 353–64.
- Willeumier, K.C.; Taylor, D.V. & Amen, D.G. 2011. Elevated BMI is associated with decreased blood flow in the prefrontal cortex using SPECT imaging in healthy adults. *Obesity (Silver Spring)* 19 (5): 1095–97.