How-To

# How To Use a SPECT Scan in the Trial of a Traumatic Brain Injury Case

by Irvin V. Cantor

To understand a SPECT scan, it is first important to distinguish structural imaging studies from functional imaging studies. X-rays, CT scans (computerized tomography), and standard MRI scans (magnetic resonance imaging)[1] are structural imaging techniques, in that they produce an image of the structure of the brain. Functional imaging studies do not provide anatomical pictures of the brain, but instead provide images of brain function. SPECT and PET scans are functional imaging studies. While this article deals with SPECT scans, the same principles discussed apply to PET scans.[2]

SPECT stands for single photon emission computerized tomography. It involves injecting the patient with a radioactive flow tracer and then producing a scan which shows the distribution of the radiotracer in the brain. The radiotracer accumulates in different areas of the brain proportionate to the relative levels of blood flow in those areas. The scan demonstrates cerebral blood flow, indicating either symmetry or asymmetry in such blood flow. The scan also demonstrates the quantitative nature of the perfusion of the blood flow where there is asymmetry, either hypo-perfusion, which is decreased blood flow, or hyper-perfusion, which is increased blood flow. It is not at all uncommon for a SPECT scan to show an area of altered blood flow in the brain even though the CT or MRI revealed no structural abnormality.

SPECT scans are relatively inexpensive, costing approximately the same as a conventional CT. They are available in several hospitals in Virginia. SPECT scans are typically conducted in the nuclear medicine departments of the hospital, and are read by nuclear medicine physicians, neuroradiologists, and some brain injury specialists.

The SPECT scan itself is a computer generated three dimensional image. Single slices of the image may be produced, in black and white (Exhibit 1, facing page) or color (Exhibit 2), or actual videos of the 3-D models may be produced (Exhibit 3).

## Introduction of the SPECT Scan Images at Trial

X-rays, CT scans, and MRI scans are routinely admitted into evidence by the courts in Virginia. Virginia law provides that radiographs are admissible when properly authenticated. This requires proof that the radiograph "is of the person involved in the case, that it was made by a competent technician, and that it accurately portrays the condition of the person's body."[3] The same requirements seemingly apply to SPECT images, which are produced by the same technique as a CT scan, computerized tomography.

There is some debate over the use of SPECT to confirm or rule out traumatic brain injury, and most reviewers seem to agree that the diagnosis of traumatic brain injury is a clinical one which depends on consideration of all relevant factors. If your opponent makes a *Daubert* challenge to the admissibility of the SPECT scan, point out to the court that the reported criticism of SPECT does not affect admissibility, only the weight to be afforded the SPECT results by the finder of fact. This is no different than a CT, MRI, EEG, or other medical scan or study of your client. Interestingly, at the 1998 meeting of the Mild Traumatic Brain Injury Group of the Aspen Neurobehavioral Institute, it was agreed that SPECT was actually more sensitive in detecting mild traumatic brain injury than

CT, MRI, or any other diagnostic scan or study.[4] In a recent Massachusetts case, the court rejected a *Daubert* challenge to a SPECT, stating that SPECT technology has been used by the medical community for at least 15 years, and "there is no dispute that SPECT shows abnormalities in brain function." The court pointed out that plaintiff's experts did not opine that the SPECT scan, itself, established the diagnosis, but rather that it was one of many factors considered by the experts in their diagnosis.[5]

The most expedient way to comply with the authentication requirements for introduction of the actual SPECT images at trial is to use requests for admission or have the opposing party stipulate these elements. If there is dispute over any of the elements of authentication, it may be necessary to call the actual technician who administered the SPECT. In most cases, there will be no dispute over authentication of the SPECT, but rather dispute over who is qualified to interpret the SPECT results and what the results indicate.

Once you determine that authentication is not an issue, it is necessary to have an expert who is qualified to interpret SPECT scans explain the images for the jury. Sometimes the treating brain injury physician can interpret the SPECT images. It is imperative that counsel be sure such clinician is qualified and capable of interpreting SPECT results. Determine what training and experience the clinician has in the interpretation of SPECT scans, as well as the number of times the clinician has previously qualified in court to testify about a SPECT scan. If there is any doubt about the clinician's qualifications to interpret SPECT scans, call to trial the actual nuclear medicine physician or neuroradiologist who originally read the SPECT. These are the same considerations which apply to the introduction of CT's or MRI's at trial.

## Use of the SPECT Scan at Trial

In the debate over the utility of SPECT to diagnose traumatic brain injury, several researchers have suggested that conditions other than traumatic brain injury could result in abnormal functional imaging studies, such as dementia, schizophrenia and other psychiatric disorders.[6] In light of such debate, counsel should use abnormal SPECT results as corroborative evidence only of the clinical diagnosis of traumatic brain injury made by the treating physicians. Rarely, if at all, should counsel rely on the SPECT results as the centerpiece of proof that your client suffered a traumatic brain injury.

When deciding to introduce SPECT images at trial, counsel should also make sure that the abnormal SPECT results are consistent with the deficits exhibited by the client after a brain injury. For example, if your client suffers from significant emotional sequelae secondary to a mild traumatic brain injury, you might expect to see abnormal SPECT results localized in the frontal lobe of the brain, as opposed to other areas of the brain that do not directly affect one's emotionality. On the other hand, for a patient who is in a vegetative state following a severe brain injury, you might expect

## Exhibits

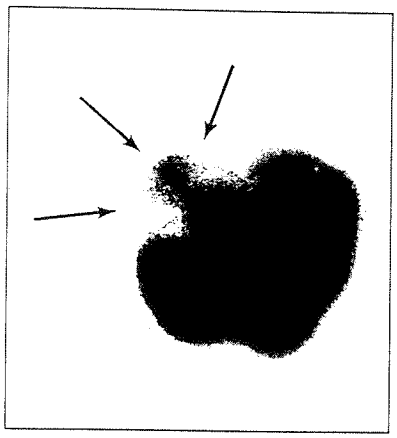

**Exhibit 1**
SPECT Scan of brain of mild TBI victim, demonstrating significant hypoperfusion in the nondominant temporal lobe. This patient's CT and MRI were unremarkable.

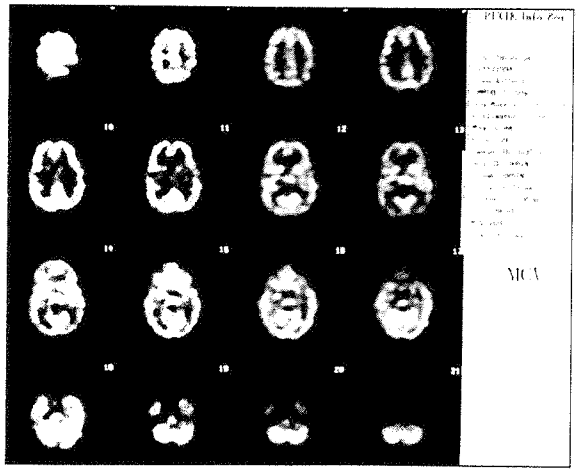

**Exhibit 2**
Colored SPECT scan iamges.

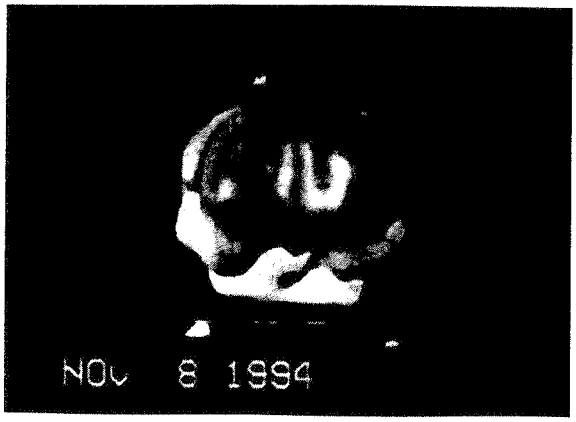


**Exhibit 3**
Still photograph made from 3-D video of SPECT scan of mild TBI victim. The 3-D computerized image provides a textured shape and form of the brain, much more discernible for the jury.

to see global reduction of cortical blood flow on SPECT.

## Conclusion

Introduction and use of abnormal SPECT images in the trial of a traumatic brain injury case may provide corroborative evidence of your client's injury and condition. SPECT abnormalities, though, are no substitute for the testimony of the clinicians and, more importantly, the lay persons who can explain the significant changes your client has suffered since the traumatic event. If you plan to introduce SPECT images at trial, you must be careful to properly authenticate the SPECT scan and have an expert who is qualified to interpret the SPECT results for the jury.

## Endnotes

1. For purposes of this article, MRI refers to standard anatomical MRI's, as opposed to functional MRI's ("fMRI"). fMRI's compare changes in cerebral blood flow between an MRI of the patient in a resting state and an MRI of the patient in a state of cognitive processing. fMRI's are unable to localize focal abnormalities like SPECT and PET and are not as widely used at the present time.
2. PET stands for positron emission tomography. It requires the patient to be injected with glucose identified with a radioactive label. The glucose concentrates in areas of brain activity, and the scan demonstrates these areas of glucose concentration.
3. *Meade v. Belcher*, 212 Va. 796, 801, 188 S.E. 2d 211, 215 (1972); *See* Friend, *The Law of Evidence in Virginia*, 4th Edition, Section 13-11, pages 562-563.
4. Although the written report from this meeting has not yet been published, the author was informed of this finding by one of the participants at the meeting.
5. *Rhilinger v. Jancies, et.al.*, No. 93-2223, Mass. Super., (Norfolk Co.). This case was reported in Mealey's *Daubert Report*, March, 1998.
6. *See, e.g.*, Kotrla, K.J., Weinberger DR., "Brain Imaging in Schizophrenia", *Annu. Rev. Med.*,1995; 46: 113-122; Starkstein, S.E., Sabe, L., Vasquez, S., Teson, A., Petracca, G., Chemerinski, E., DiLorenzo, G., Leiguarda, R., "Neuropsychological, Psychiatric, and Cerebral Blood Flow Findings in Vascular Dementia and Alzheimer's Disease," *Stroke*, 1996, 27(3): 408-414.

*Irvin V. Cantor is a partner in the Richmond firm of Cantor, Arkema & Edmonds. He is a 1978 graduate of the University of Virginia Law School and former law clerk to the Virginia Supreme Court. A major portion of Mr. Cantor's practice involves the representation of victims of traumatic brain injuries. Currently he serves as a Vice President for Virginia Trial Lawyers Association.*