Refuting Diagnostic and Neuropsychological Testing in Toxic Tort Cases

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I. Introduction

Chemicals are a part of our everyday life. They are in the air we breathe, the food we eat, and the water we drink. We use them to kill the insects and parasites that destroy our food, to clean the clothes we wear and the vehicles we drive, and to process and manufacture the goods we purchase and employ on a daily basis. It is, quite simply, impossible to escape exposure to a wide range of chemicals, all of which are toxic if ingested in sufficient amounts or if we are exposed to them for a significant period of time.

In recent years, there has been an explosion in toxic tort litigation. Plaintiffs from all walks of life are making claims that their exposure to various chemicals in the atmosphere, in their foodstuffs, in their drinking water, and in their workplaces, have led to serious personal injuries. One of the most common claims that is associated with toxic tort cases is the claim of "indirect" brain damage. In order to effectively defend these types of cases, and refute claims of toxic brain damage, defense counsel must understand the types of diagnostic tests that are often used to support a claim of toxic brain injury and the limitations and procedural drawbacks of those particular tests. Defense counsel must also understand the nature, strengths, and weaknesses of a plaintiff's main diagnostic tool in the toxic

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brain injury case: neuropsychological testing. The purpose of this Article is to provide defense counsel with the information they need to effectively defend against and ultimately refute claims of toxic brain injury.

II. A Case Study

A few years ago, one of the authors of this Article was defending a case involving an alleged toxic brain injury.[1] This case provides a fine example of the different types of expert witnesses that can be utilized by the defense in a toxic tort case.

The case involved a nineteen-year-old man who was employed as part of a small workforce at a suburban Chicago silkscreening plant. The relatively small physical plant where this man worked was equipped with various air circulation devices, including windows, doors, hooded circulation vents, and fans. The silkscreening processes performed at this plant regularly employed various chemicals and chemical compounds. This particular plaintiff claimed that one day, as he was performing his routine tasks as a silkscreener, he was overcome by fumes from the chemicals he was using, lost consciousness, fell and struck his head. Upon striking his head he developed a subdural hematoma. The plaintiff further alleged that, in addition to the injuries he received as a result of the toxically induced loss of consciousness and subsequent hematoma, he suffered extensive brain damage as a result of long term exposure to the chemicals used in the silkscreening process.

In order to refute the plaintiff's claims of brain injury caused by his exposure to the silkscreening chemicals, the defendant assembled a team of expert witnesses. Each expert played a particular role in the defense of this case, and through their combined efforts with the defense attorneys, the case was settled in the early stages of trial. The team of defense experts in this case included a toxicologist-chemist, an environmental engineer, a neurologist, a psychiatrist, and a neuropsychologist.

The job of a toxicologist is to study the adverse effects of chemical agents on biological systems. In this particular case, the toxicologist was

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[1] Robert Norlander v. Lovejoy Indus., Circuit Court of Cook County, Illinois, Docket No. 91L9079.

used to identify the concentration levels of active toxins that would cause symptomology in a human being. The toxicologist provided testimony regarding the duration and degree of exposure that would be necessary to produce harmful effects.[2] In addition, the toxicologist was used to determine precisely which chemicals the plaintiff was exposed to.

The environmental engineer was utilized to perform air quality tests and to determine the concentration in the plaintiff's workplace of the various chemical components used in the silkscreening process. In addition, the environmental engineer reviewed the air quality tests performed by the plaintiff's experts and the conclusions derived from them in order to analyze their validity. Moreover, the environmental engineer provided testimony regarding various factors which would effect the ambient air quality at the plaintiff's place of employment. Such factors included the use of fans, vents, air circulation devices, and similar items.

The neuropsychologist was utilized to test the plaintiff's cognitive abilities in an effort to determine his brain function. The neuropsychologist, through a battery of neuropsychological tests, attempted to measure the plaintiff's higher level cortical functions, such as reasoning, memory, and language. The plaintiff's scores on the various sub-parts of the neuropsychological test battery were then compared to norms in an effort to determine whether the plaintiff's scores were indicative of brain damage.

The neurologist was used to conduct a medical examination of the plaintiff and to assess the plaintiff's alleged neurological deficits. In addition, the neurologist was used to review the plaintiff's CAT scans and all of the plaintiff's medical records for signs of congenital or other preexisting neurological problems. The neurologist also analyzed the causation issues, relying in part on the test results and opinions of the toxicologist, environmental engineer and neuropsychologist. Moreover, the neurologist was used to refute the opinions proffered by the plaintiff's

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[2] Everything in nature is made of chemicals and there is no such thing as a chemical which is free of harmful effects if the dose is too high. For example, 15 quarts of water, 5 pounds of sugar, and seven ounces of salt are all considered lethal doses of those particular chemicals. The job of the toxicologist is to determine when a dose of a particular chemical reaches the level necessary to produce harmful effects. Dr. William J. Waddell, *Understanding the Chemistry of the Case and How it Relates to Toxicology*, DRI Chemical Exposure Seminar, E-1, E-3 (1993).

expert neurologists and to point out the inadequacies of the neurological testing and examinations performed on the plaintiff.

Finally, a psychiatrist, like the neurologist, was used to review the plaintiff's pre- and post-accident psychological, medical, employment, and school records. He was also used to bolster the defendant's contention that the plaintiff suffered no long term brain damage and that the plaintiff's alleged short term problems were more likely attributable to environmental and social factors rather than to his exposure to the silkscreening chemicals. His opinions regarding whether the plaintiff was brain damaged and the cause of the brain damage provided the most complete explanation to the jury. His testimony relied on and explained the importance of all of the opinions and testing of the toxicologist, environmental engineer, neurologist, and neuropsychologist.

Obviously, it is impossible to discuss in detail the role of each expert in a toxic tort case. As we mentioned earlier, the purpose of this Article is to explore the various diagnostic tests that are used by health care practitioners in an effort to identify brain damage, the limitations and procedural drawbacks of each of those particular diagnostic tests, and to provide an in-depth analysis of the increasing use of neuropsychologists and the myriad of weaknesses associated with neuropsychological testing.

III. The Sequelae of Brain Injuries

A person suffering from a brain injury usually exhibits signs of impairment in one or more of three categories: (1) somatic, (2) cognitive, and (3) behavioral.[3] The somatic or physical complaints and disabilities can include photosensitivity, double vision, reduced noise tolerance, insomnia, nausea, neck pain, alcohol intolerance, lack of energy, and speech, hearing, and olfactory dysfunction.[4] On a cognitive level there may be deficits in immediate short- and long-term memory, concentration

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[3] *See* Alexander J. Nemeth, *Litigating Head Trauma: The "Hidden" Evidence of Disability*, 12 AM. J. TRIAL ADVOC. 239, 248 (1988); Richard C. Senelick, M.D., *Head Injury: A Primer*, 59 DEF. COUNSEL J., Apr. 1992, at 245, 247-48; Glenn Cahn & Susan Miller, *Closed Head Injuries: Understanding The Issues*, 24 TRIAL, Apr. 1988, at 33; Dr. Thomas Park, *Closed Head Injury: A Serious, Quickly Growing Problem*, MICH. LAW. WEEKLY (July 27, 1992).

[4] Nemeth, *supra* note 3, at 249.

problems, slowed thinking, reduced ability for simultaneous mental retention of several items of information, abnormal mental fatigability, reduced speed in solving problems, failure to recognize familiar things, an inability to understand spoken or written words, an inability to carry out skilled, complicated movements, and problems with perception, sequencing, judgment and communication.[5] Possible behavioral consequences of a brain injury include depression, lack of empathy, anxiety, sexual dysfunction, mood swings, irritability, social withdrawal, reduced emotional closeness and trust in personal relationships, confusion, and exacerbation of pre-injury emotional vulnerabilities.[6]

IV. The Problems Associated With Relying on Regular Diagnostic Tests to Assess and Prove Brain Damage

Plaintiffs and their attorneys have, for several years, turned to sophisticated diagnostic tools like x-rays, computerized axial tomography (CAT) scans, magnetic resonance imaging (MRI) scans, electroencephalograms (EEGs), cerebral arteriographs, positron emission tomography (PET) scans, and single photon emission computerized tomography (SPECT) scans in an effort to detect brain damage.[7] As sophisticated as these tests are, however, they are simply not up to the challenge of detecting the type of damage commonly associated with toxic chemical exposure. Defense counsel should be extremely wary when confronted with a plaintiff who claims that one of the above-referenced diagnostic tests is concrete proof of chemically induced brain damage.

X-ray machines use photographic plates to capture images of the electromagnetic radiations that are emitted from a substance when it is bombarded by a stream of electrons moving in a vacuum at extremely high velocity.[8] X-rays are ideal for diagnosing fractures and other

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[5] *Id.*

[6] *See id.* at 247.

[7] E. Marcus Davis, *Mild to Moderate Brain Injury: A Silent Epidemic*, 26 TRIAL, Nov. 1990, at 109, 111.

[8] STEDMAN'S MEDICAL DICTIONARY 1967 (Marjory Sprayear, ed., 26th ed. 1995).

abnormalities in bony structures, but are not at all helpful in diagnosing damage to soft tissues.[9] X-rays would most certainly not be beneficial in detecting the type of microscopic brain damage that may be caused by long term exposure to toxic chemicals.[10]

Computerized axial tomography (CAT) scans produce a cross-sectional image of the brain.[11] During a CAT scan, a computer receives information from x-ray beams and reconstructs an image of the scanned organ on the computer monitor.[12] The x-ray source and the electronic receiver move about an axis, which creates a clear, black and white, cross-sectional image of the organ on one plane.[13] The problem with CAT scans is that, although they produce clear cross-sectional images of the physical structure of the brain, they cannot identify smaller injuries often associated with toxic exposure.[14] "Superficial contusions of the cortex are frequently obscured on CAT scans by contiguous bone."[15] In addition, small hypothalamic and brain stem infarcts cannot be seen on CAT scans and "injuries of the cerebral white matter, unless hemorrhagic, usually are not identifiable."[16]

Magnetic resonance imaging (MRI) scans do not use ionizing radiation like an x-ray.[17] Instead, MRIs use a combination of radio waves and magnetic fields to generate an image.[18]

> MRI is a technique based on imaging of the hydrogen protons in the body. As the patient enters the magnetic resonance scanning field, millions of the billions of hydrogen protons in the body align themselves with the magnetic

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[9] Richard A. Deyo, *Diagnostic Imaging of the Lumbar Spine: Are We Doing Too Much?*, 2 HIPPOCRATES' LANTERN 3, 2 (1993).

[10] *Id.*

[11] Nemeth, *supra* note 3, at 252 n.21.

[12] Deyo, *supra* note 9, at 2.

[13] Nemeth, *supra* note 3, at 252 n.21.

[14] Davis, *supra* note 7, at 111.

[15] Robert A. Zimmerman et al., *Head Injury: Early Results of Comparing CT and High-Field MRI*, 7 AM. J. NEURORADIOLOGY 757, 759 (Sept./Oct. 1986).

[16] *Id.* at 759.

[17] RUTH G. RAMSEY & MARY SCHEER-WILLIAMS, PSYCHOLOGICAL DAMAGES: ADVOCACY AND DEFENSE § 1.6 (1988).

[18] *Id.*

> field. The subsequent application of an intermittent radio frequency (RF) wave causes the aligned protons to tilt off their axis. After discontinuing the radio wave, the protons gradually realign in the field. As they realign they discharge a small amount of energy, and take a finite amount of time to realign. The energy, time, and location [of the protons] are measured, translated to a gray scale, and [then] imaged.[19]

Different tissues and organs, both normal and unhealthy, display a different signal intensity on the final magnetic resonance image.[20] It is these subtle differences in signal which form the basis of magnetic resonance imaging.[21] MRIs, like CAT scans, are far from reliable in detecting subtle organic brain damage.[22] In some cases, MRI scans cannot be used to identify even acute subarachnoid hemorrhaging, much less the microscopic tissue damage normally associated with toxic chemical exposure.[23]

"An electroencephalograph uses electrodes attached to the scalp to record the electrical currents that are generated by the brain. [This] procedure yields a lineal record of the currents called an electroencephalogram (EEG)."[24] By measuring electrophysiological or metabolic brain function, the EEG records gross brain activity.[25] However, EEGs can often be inaccurate, even on patients with moderate brain damage, unless the patient has a seizure during the test.[26] Consequently, electroencephalograms, like MRIs and CAT scans, are not at all reliable in predicting the microscopic brain damage typically highlighted in toxic tort cases. As such, defense attorneys should be on their guard when plaintiff's claim that the results of these tests prove that they have organic brain damage.

Cerebral arteriography or angiography is performed by obtaining serial fast x-ray images of the brain during the administration of contrast media

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[19] *Id.*

[20] *Id.*

[21] *Id.*

[22] *See* Davis, *supra* note 7, at 111.

[23] *Id.*

[24] Nemeth, *supra* note 3, at 252 n.20.

[25] Davis, *supra* note 7, at 111; *see also* Frederick S. Kadushin, *How to Assess Brain Damage: Neuropsychological Evaluation for Litigation*, 26 TRIAL, Oct. 1990, at 64.

[26] Davis, *supra* note 7, at 111.

into the arteries.[27] This contrast media provides an outline of the intracerebral vessels as it circulates within them.[28] Competency, distribution, and configuration of the arteries and other intracerebral vessels can be ascertained from these images.[29] Cerebral arteriography is, by its very nature, limited to the imaging of the intracerebral blood vessels.[30] If the chemical which was allegedly involved in injuring the plaintiff is not recognized as a chemical which affects the intracerebral blood vessels, a cerebral arteriography will not help the plaintiff prove his case of toxically induced brain damage.

As plaintiffs have sought new and different ways to produce direct evidence of chemically induced brain damage, they have embraced two relatively new diagnostic medical procedures: the positron emission tomography (PET) scan and the single photon emission computerized tomography (SPECT) scan.[31] The compelling visual effects that these computer-aided scans produce virtually guarantee that PET and SPECT scans will be proffered as evidence of brain damage in an ever increasing number of toxic tort cases.

PET scans measure metabolism.[32] "This is accomplished by injecting into the patient a radioisotope tracer which 'tags' glucose in the bloodstream."[33] After the patient is injected with the radioisotope, he lies on a sliding table which is then placed in the middle of a circular scanner.[34] While the patient's head is kept in a still position, the PET scanner detects gamma rays from the positron-emitting radioisotopes and collects multiple images of the patient's brain from different angles.[35] "The

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[27] Mariano Fernandez-Ulloa, *Diagnostic Imaging With SPECT in Traumatic Brain Injury*, 3 HIPPOCRATES' LANTERN 4, 5 (1995).

[28] *Id.*

[29] *Id.*

[30] *Id.*

[31] Brickford Y. Brown & Samuel L. Tarry, Jr., *Does Your PET Bite? The Misapplication of Brain Scan in Toxic Tort Litigation*, 39 FOR THE DEF., Mar. 1997, at 30.

[32] *Id.*

[33] *Id.*

[34] *Id.*

[35] *Id.*

computer then processes the information collected [by the PET scanner] and produces color-coded images of metabolism throughout the brain."[36]

SPECT scans are performed in much the same way as PET scans, but are a much cheaper alternative since they utilize readily available radioisotopes.[37] "Because the spacial resolution of SPECT technology is inferior to PET [technology], the resulting images are less exact, with the colors tending to blur together."[38] SPECT scans can only indirectly measure cerebral metabolism.[39] SPECT scans are viewed by clinicians as a measure of cerebral "profusion" or blood flow.[40] Hence, whenever there is a restriction of the blood supply in the brain, the radioisotopes cannot concentrate in the affected area and will show up as voids or "cold" lesions on the SPECT scan.[41]

Defense counsel can attack a plaintiff's use of PET and SPECT scans in a variety of ways. First and foremost, plaintiff's reliance on PET or SPECT scans should be attacked through the use of a motion based on *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[42] Much has been written about the *Daubert* decision, and the authors will not belabor that decision's important legal significance here. However, it should be noted that both PET and SPECT scans have been the subject of much criticism by the scientific community as not having met acceptable scientific levels of methodology and criteria, and that they "have not reached the level of sophistication and reliability necessary to diagnose neurological or cognitive deficits."[43] As such, these tests are the type of scientific evidence the *Daubert* decision was designed to eliminate from courtroom proceedings. Indeed, some courts, in applying the *Daubert* philosophy, have refused to allow plaintiff's experts to rely on PET and SPECT scans as evidence of the plaintiff's neurological or cognitive deficits.[44]

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[36] Brown & Tarry, *supra* note 31, at 30.

[37] *See id.*

[38] *Id.* at 30-31.

[39] *Id.* at 31.

[40] *Id.*

[41] Fernandez-Ulloa, *supra* note 29, at 5.

[42] 509 U.S. 579, 113 S. Ct. 2786, 125 L. Ed. 2d 469 (1993).

[43] Brown & Tarry, *supra* note 31, at 33.

[44] *See, e.g.*, Summers v. Missouri Pac. R.R. Sys., 897 F. Supp. 533 (E.D. Okla. 1995).

If a *Daubert* motion is not successful, defense counsel should be prepared to elicit testimony that PET and SPECT scans are quite variable and are subject to a great many dependent factors. To begin with, the equipment used in both types of scans comes in different configurations: camera based or non-camera based, high resolution or low resolution, and single or multi-head systems.[45] In addition,

> the quality of a specific scan is dependant on many factors, including: the equipment used, the filters used, the tracers used, the time between the tracer injection and the scan, the duration of the scan, the mental state of the patient during the scan, movement of the patient during the scan, audio and visual stimulation of the patient during the scan, the alignment of the scanner to the patient, variations in the processing and display of the scan, the method of reconstruction and analysis, and the overall quality of the scan.[46]

All of these variables make it almost impossible for a witness to honestly testify that a plaintiff's PET or SPECT scan permits him to determine the cause of any abnormalities seen on the scans.[47]

Defense counsel should also realize that the typical methods of interpreting PET and SPECT scans are highly subjective and can vary from one interpreter to another, based on the interpreter's experience, expertise or clinical bias.[48] "Subjective differences in interpretation can occur even between institutions, based on differences in equipment, institutional experience, and protocols.[49]

Defense counsel should also be aware of, and should not hesitate to make an issue of, the fact that the most basic parameters for PET and SPECT scan interpretation–the terms "normal" and "abnormal"–do not have common and universal definitions.[50] PET and SPECT scans suffer from a lack of standardized definitions, a lack of standardized quantitative analysis, a lack of published standards, and a lack of a recognized

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[45] Brown & Tarry, *supra* note 31, at 34.

[46] *Id.*

[47] Indeed, this causal connection argument can be made with respect to any of the tests discussed herein. Although any of the tests discussed may show evidence of brain damage, *none* of the tests can determine the cause of the depicted brain damage.

[48] Brown & Tarry, *supra* note 31, at 34.

[49] *Id.*

[50] *Id.*

protocol for producing PET and SPECT scans to identify specific diseases.[51] All of these points should be brought to the attention of the trier of fact to illustrate the tenuous nature of these particular types of diagnostic imaging techniques.

One other point deserves to be mentioned regarding PET and SPECT scans. Defense counsel should always ascertain whether the PET or SPECT scans at issue were performed by a physician certified by (1) The American Board of Radiology, (2) The American Osteopathic Board of Radiology, or (3) The American Board of Nuclear Radiology. If the physician who performed the scans was not certified by one of these three bodies, then he received his license to perform PET or SPECT scans directly from the Nuclear Regulatory Commission and may not be board certified in any medical specialty.[52] Such information may be effectively used to impeach the credentials of the individual responsible for producing the images that allegedly show signs of brain damage.

As we have outlined above, there are serious drawbacks associated with having to rely on the aforementioned diagnostic tests in order to prove brain damage. As a result, plaintiffs and their attorneys often rely on neuropsychological testing to "assess" brain damage in toxic tort cases. We now turn to a discussion of that type of testing.

V. What Is Neuropsychology?

Neuropsychology, a sub-specialty of psychology, studies the relationship between the brain, behavior, and the behavioral consequences of brain damage."[53] Clinical neuropsychologists, the practitioners in this relatively new field, assess how and to what extent brain trauma or brain disease affects a person's ability to perceive, think, memorize, judge, feel and act.[54] Such determinations are made through the use of a neuropsychological evaluation and several different neuropsychological test batteries.[55]

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[51] *Id.*

[52] Fernandez-Ulloa, *supra* note 29, at 8.

[53] Damion T. Wren & Louis S. Greenfield, *Dealing With Neuropsychological Evidence*, 31 FOR THE DEF., July 1989, at 11.

[54] *Id.*

[55] *Id.* at 12.