Understanding Head Injury and Intellectual Recovery from Brain Damage: Is IQ an Adequate Measure?

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A person's intelligence (or IQ) has long been synonymous with cognitive and general abilities to function daily on an effective level. When traumatic brain injury occurs, there is a natural desire to find some measure that identifies the amount of damage that has occurred and whether it is permanent or temporary. Given the popularity of the IQ test, there is a tendency to use this measure as such a yardstick. It is argued that such a global measure is not appropriate. The predominant reason that it is not a wise choice is that the IQ test does not tap into many of the critical areas of a person's functioning, such as personality regulation, shorter-term memory, various types of attentional capacity, and the ability to organize and plan effectively. Rather, to truly and accurately reflect a person's neuropsychological strengths and weaknesses requires the use of many different measures, not just a single one such as an IQ score.

Head injuries affect an estimated one to eight million individuals every year in the United States,[1] with the vast majority of these being minor in nature. Even so, head injury leads to an estimated 500,000 to 700,000 hospitalizations and 100,000 deaths annually.[2] Many of these cases may result in lawsuits. Consequently, there is a need to be able to measure how much brain damage has occurred, as well as whether it is permanent or temporary. Such knowledge is needed to help determine the degree of compensation that may be due the individual.

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The Common Symptoms of Head Injury

In the mildest cases of head injury ("minor" HI), which are the vast majority, only superficial damage, such as cuts and bruises, is done to the face or scalp. The brain itself sustains no injury. The next step in severity is "mild" HI, in which some degree of damage has been sustained by the brain; there is, however, only limited agreement on the definition

of "mild" HI and on how to measure and quantify the degree of injury. Common symptoms that may occur early (from immediately after to within the first few days after the accident) include headache, nausea and/or vomiting, blurred vision, dizziness, memory impairment, and loss of consciousness. The length of time that symptoms persist varies, although there is a fairly linear correlation between duration of symptoms and severity of the brain damage. With mild cases of head injury, in which complete recovery is to be expected, symptoms may last for only seconds, minutes, or a few days. When symptoms persist for months, years, or decades, there is greater probability, if not certainty, that permanent harm has been done to the brain.

Symptoms of mild HI that typically appear later (weeks or months after the accident) can include personality change, such as increased irritability and decreased frustration tolerance, impatience, disinhibition, depression and social withdrawal, and a slower rate of thinking. The presence of such symptoms, months or years after a HI, is again considered to be suggestive of permanent brain damage.

"Severe" head injury, such as can be witnessed in patients who are in long-term coma states or who may be conscious but in a vegetative state, will not be discussed here. As compared with milder HI, where there can be considerable legal debate as to the presence and importance to daily life of any brain damage, the harm sustained by severe HI patients is more clear cut, and therefore little detailing of the issue is required.

Types of Brain Damage

In working with potential HI clients and attempting to understand their symptoms, it is helpful to have some knowledge as to why and how the brain is being damaged. There are two classes of head injury: "open" and "closed." Open HI occurs when the skull has been fractured, broken, or penetrated, for example from a fall, by impacting something such as a car windshield, or from missiles such as bullets. Closed HI (CHI) occurs when the skull remains intact, but injured. Outside of war zones, CHI is more common and typically causes greater damage to the brain than open HI. The simplest way to explain this is that when the skull fractures, some degree of the imparted energy is absorbed and therefore not transmitted to the brain. Such a situation is analogous to the bumper and assorted sheet metal parts of a car folding up in a car accident, thereby absorbing and reducing the energy that is transmitted to the passenger compartment, so that the personal safety of those within is enhanced.

Within the category of CHI, damage to the brain can result from several different means. First, in what are often referred to as acceleration-deceleration injuries—such as happens in car accidents—the skull is typically flung forward upon the initial impact. At some point in time, the body (and skull) is stopped and restrained, for example by a seat belt or by hitting the windshield, whereupon the brain, which is somewhat free of the interior skull, snaps up to speed and is flung forward. The brain is then stopped by the interior skull walls. When there is great

enough force involved, there is the potential for a "ricochet" effect, in which the brain bounces back in the opposite direction and smashes into bone again. Such injuries are referred to as "coup" and "contrecoup." Damage from contrecoup effects can be considerable and may in fact be worse than the coup injury.

It should also be appreciated that soft brain tissue matched up against hard bone will always come out second best. Consequently, when the brain is thrown into a skull wall—which is rather jagged and rough in texture—considerable harm (cuts, bruises, and damaged blood vessels) can be done to the brain.

Brain injury can result from means other than the brain being smashed into the skull. In some injuries that can arise in acceleration-deceleration incidents, a spinning motion is imparted to the brain so that it rotates around the brain stem, which arises off the relatively rigid and fixed spinal column. In the process, the brain cells, along with blood vessels, are being stretched, shorn, and ripped, all of which can cause temporary or permanent damage.

A third potential source of CHI, or traumatic brain injury (TBI), is excess fluid, such as edema or leaking blood, inside the skull. There is little free interior space in the skull, and when there is too much fluid, brain tissue is compressed. Such compression again can result in either temporary or permanent disabilities.

A fourth form of TBI can result even when the head has not received any kind of physical blow. These cases include reduction or total loss of oxygen or blood sugar such as can arise from drowning, heart failure, hypoglycemia (low blood sugar), or carbon monoxide poisoning. Although such cases may not be thought of as true head injuries, in that the skull has not been impacted, nonetheless, the term HI is commonly used to describe them.

It should also be understood that there are many other variables, beyond whether a HI was open or closed, that can impact the patient's prognosis. One of these variables is age. Most research and therefore knowledge that exists about TBI is on the adult population, roughly defined as between 21 to 65 years old. Persons above and below those ages present special problems, which makes understanding their injuries all the more difficult.

A major difficulty in working with pediatric head injury results from the unique quality of children: they are still developing mentally. Adults, by definition, have acquired the basic foundation of knowledge that they will need throughout their lives. Therefore, when an adult suffers a HI, the question becomes: what skills have been lost, to what degree, and what has been spared? With children, the added question is: "what growth process has been arrested, changed, or destroyed?"[3] For instance, if a preschooler suffers a certain type of head injury before language development has occurred to a sufficient extent (roughly between the ages of two and three years), major cognitive alterations can be expected to result. Measured later in life, language deficits will likely be gross—but at the same time other areas, such as "mechanical aptitude," may be greatly overdeveloped. Both language and mechanical ap-

titude are simultaneously undergoing cerebral development in the preschool years. So, with such a TBI (in a preschool child), the case becomes one of "robbing Peter and paying Paul." Clearly, looking only at what has been lost and spared does not address the special situation of a pediatric HI, given the developmental alterations that can result.

Geriatric head injury is unique for a different reason. Within the age group of 21 to 65 years old cognitive abilities are relatively stable. Obviously there is some decline with each advancing decade, but the changes are slow, gradual, and limited in their impact on the ability to live an independent, satisfying, and productively functional life. Starting roughly in the mid-60s, and definitely by age 70 or 80, the brain undergoes considerable aging, which can include physical atrophy, as well as other disorders such as strokes, and the encephalopathic effects of other chronic diseases of the kidneys, liver, or lungs. The elderly also are often taking numerous medications, which can have deleterious side effects on cognition and personality. Consequently there is a need to differentiate brain dysfunction due to "normal aging" and medication side effects versus that which might be attributable to a particular TBI. Moreover, there is a far greater frailty in the aged population, with consequent mental and physical debility, incapacity, or deterioration. For instance, a simple "bump on the head" that may lead to nothing more than a transient concussion in a younger adult might end up causing a stroke (due to more fragile blood vessels), with permanent disability, in a geriatric patient. Legally evaluating only the initial bump ("The car accident was just a 'fender bender' so what's the big deal?") and not the longer-term consequences obviously is doing an injustice to the patient.

Finally, there are many ways for the brain to be impaired without its necessarily being the result of—or appropriately diagnosed as—a HI. For instance, mental retardation due to Down's syndrome limits intelligence from birth; but that is due to a genetic defect and not a TBI. Some children are born with specific learning disabilities and do poorly in one or more subjects in school, such as spelling or math, but otherwise have no specific cognitive, emotional, or social deficits. Learning disabilities often arise for unknown reasons, and a head injury is by no means the necessary cause of their development.

Other brain impairments may cut a wider swath, effecting cognition as well as social and emotional development, as can be seen in the effects of attention deficit disorder (ADD, sometimes referred to more simply as "hyperactivity" in children). However, there are some symptoms of ADD quite distinct from head injury effects. For instance, ADD patients are typically very restless and have difficulty sitting still, which is not expected in a TBI client. Moreover, ADD typically is seen as having no known precipitant, or it may "run in the family" genetically. Head injuries by definition have a particular cause, which often can be localized to a very specific point in time (e.g., a particular car accident or industrial fall). The point is that brain impairment is not necessarily synony-

mous with head injury. The age at which something arose, genetic predispositions, how widespread the impact is on the person's overall life, and the specificity to a particular point in time can all play an important role in differentiating HI from other forms of brain damage.

Brain Damage and Intelligence

When brain damage does result from an injury, sustained perhaps in a motor vehicle or industrial accident, there is an implicit assumption that a person's intelligence may be adversely affected. Numerous definitions of intelligence have been used over the years. One of the simplest is from the developer of a commonly administered IQ test, David Wechsler, who said that intelligence "is an overall competency or global capacity, which . . . enables a sentient individual to comprehend the world and to deal effectively with its challenges."[4] Given that intelligence may be impacted by brain damage, one would expect that the intelligence (or IQ) test would be an appropriate means of evaluating it. Information that might be discerned from it would include how much damage to the brain had occurred initially and how complete a recovery has been made over a period of time after the accident.

In assessing intellectual functioning—be it in head injured or normal individuals—IQ tests are valuable for several reasons, including the fact that they are well accepted throughout society. They have standardized and quantitative norms that are easy to understand, rather than the more "murky" and subjective terms that some tests may employ in describing personality. Intelligence, and the tests that measure it, is understood to be a useful predictor for success in life, be it educational or occupational. Consequently, it is a logical choice to employ IQ tests when evaluating brain damage in personal injury lawsuits.

Some research has found that IQ scores are approximately average in head-injured individuals.[5] That is, although there may be temporary losses shortly after an accident, permanent brain damage is not to be expected, at least after the milder forms of head injury.

On the other hand, a single, global measure of intelligence functioning, such as the IQ score, is frequently seen as an insufficient assessment of the degree and permanency of brain damage.[6] That is, the return of the IQ score to its premorbid level does not necessarily imply that the individual has made a full recovery.[7–9] Standardized IQ tests do not adequately assess the numerous areas of functioning (such as stamina, motivation, and speed of thinking) that are critical for intelligence. Other areas that may not be appropriately assessed include shorter-term memory, different forms of attention, and "executive skills" (such as organization and planning). There are also personality factors, such as the ability to appropriately control behavior in socially expected ways,[6, 10, 11] that the IQ test does not examine.

In fact, it is skills such as the ones noted above that are found to differentiate individuals who return to work after a head injury from those who remain unemployed or underemployed.[11–13] In that the IQ test does not tap into such skills to

a sufficient degree, if at all, it is effectively blind to much of the initial as well as lasting impairment that results in personal-injury brain damage legal cases. Hence, sole reliance or overdependence on such a well known measure as IQ is inappropriate and a disservice to meeting the needs of a client.

Case History

A case history may help illustrate this point. An Ivy League honors student (with a premorbid IQ estimated around 140) was accidentally exposed to a toxic chemical. Emergency medical treatment was administered, and the chemical was purged from her body. Two months after the accident, her IQ was tested at 127. Given that most "mild" CHI patients have IQs approximating their preaccident scores (within perhaps one to five points), such an IQ is an appreciable drop. However, after another 1.5 years her IQ once again tested at 140.

Plaintiff's counsel argued in court that the return of IQ did not measure the significant permanent brain damage suffered by the plaintiff, because the major injury she sustained was to her short-term memory. Such impairment resulted in her inability to remember much of anything that occurred after the poisoning. For example, she has no recollection of visiting with family members or attending recreational events. She is unable to remember what she wore the day before, unless she puts pins in the clothes to remind her that a particular outfit was worn recently. She cannot absorb new information with ease and generally cannot remember appointments or meetings unless she records them in a notebook that she keeps with her at all times.

Defense counsel argued that while these memory problems may or may not be true, the "objective" evidence was that she still had an IQ of 140 and therefore was quite brilliant. The medical issue then became whether an IQ of 140—coupled with a significantly lower memory score of 111—adequately reflected the extent of the plaintiff's brain damage.

The jury found liability against the defendants and awarded significant damages to the plaintiff. The jury doing so suggested that they agreed with plaintiff's counsel that merely looking at IQ numbers was not the appropriate measure of permanent brain damage in such a case.

This case illustrates several points. One is the hazard of relying on the IQ as a measure of long-term outcome after brain damage has occurred. Clearly, given the nature of the plaintiff's complaints, such as impaired memory, the IQ score by itself was not representative of her "global capacity to comprehend . . . and deal effectively with . . . challenges."[4] A second issue is that a better measure—and predictor—of her long-term outcome was the initial drop in score.[14] That is, patients with greater losses early on may show larger amounts of improvement over time in that they have more room to improve. But such individuals continue to have measurable chronic deficits in proportion to their early losses.

A third issue is the disparity between the IQ drop of 13 points versus the much greater loss in the memory score. (The Wechsler memory test tends to generate scores that are roughly commensurate

with a person's IQ score, as a rule.) IQ is typically thought of as relatively stable throughout life. Shorter terms of memory, on the other hand, are quite fragile and can be disrupted by numerous causes. Therefore, simply to look at the number of IQ points lost or to say that the loss in IQ was "only temporary" is to miss the point. Saying that the drop was "only 13 points" and was much less than the loss on the memory test, or that it was only temporary, is also beside the point. No loss of that magnitude should have occurred if this was no more than a "minor" HI.

A fourth issue for the plaintiff's attorney to be aware of is the need to employ other neuropsychological measures to assess the intellectual and emotional status of the client. Clearly, in the case noted above, more sophisticated and sensitive measures of memory needed to be employed. In fact the client was evaluated for memory functioning several times over the first two years and was always found to be appreciably weak in this area. Such a finding was expected and consistent with poisoning by the toxic chemical to which she had been exposed; it was also a more accurate representation of the problems she had with memory functioning on a day to day basis.

Fifth, there is a need to be on guard against making the mistake that "hard" tests done by a medical doctor, such as a CAT or MRI scan or an EEG ("brain wave" test), will be better at determining the presence and degree of a TBI than softer tests such as the IQ or memory measures offered by neuropsychologists.[15] Such medical tests are concerned more with the *structure* and not the *function* of the brain. That is, they might tell you if there is damaged tissue or a leaking blood vessel—but they offer no firm evidence as to how such damage impinges on the patient's daily life. Moreover, such medical tests have a notoriously high rate of "false negatives," meaning that they frequently indicate that no problem exists when in fact brain damage has been sustained. Such medical tests have a place in legal evaluations of a TBI patient, but they should be understood as being complementary to and not a replacement for an evaluation measuring actual cognitive and personality functioning.

Conclusion

The IQ test does have a place in assessing brain damage in personal injury lawsuits. However, the more diligent attorney will ask for additional measures of cognitive and personality functioning. Areas to cover should include attention, memory, executive functions, and behavioral control to help insure that test findings are an accurate portrayal of the client's deficits after a head injury.

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