Pituitary Dysfunction After Traumatic Brain Injury: The Medical, Economic and Legal Implications For Victims

Introduction

The following article analyzes medical issues associated with pituitary dysfunction in patients who sustain traumatic brain injury (TBI). Although, broadly speaking, the symptoms and effects of injury to the brain itself have long been well understood, only fairly recently has research been devoted to injury to the pituitary gland in these patients. Most current research shows that between 30 and 50 percent of TBI patients have some degree of pituitary dysfunction, although some studies place the figure lower or higher.

These findings are of particular interest from both a medical and legal perspective because the symptoms of pituitary dysfunction are often similar to the symptoms of brain injury, which means it can be difficult to identify the actual cause of the patient's symptoms. At the same time, tests that are used to diagnose brain injury generally are not able to detect damage to the pituitary gland, creating a disconnect between the diagnosed injury and the observable symptoms. Bridging this gap has significant implications for the practice of medicine, for legal cases arising from these injuries, and, most importantly, for patients' recovery and quality of life following a pituitary injury.

About Traumatic Brain Injuries

Put broadly, a traumatic brain injury (TBI) is an injury causing brain dysfunction involving outside force. There are two types of traumatic brain injuries:

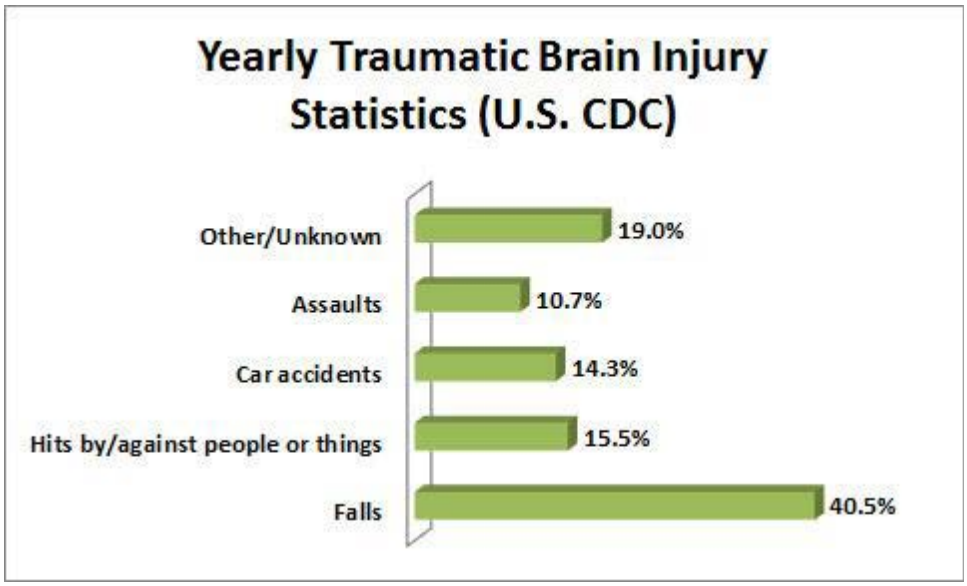
- **Closed head injuries** involve trauma to the brain caused by the brain knocking against the skull. Usually these injuries involve a blow to the head or a sudden, violent motion of the head that causes the brain to move inside the skull.
- **Open head injuries**, or penetrating head injuries, involve an object actually piercing the skull and penetrating the brain.

This article will focus primarily on closed head injuries, as this is the mechanism by which damage to the pituitary gland is most often inflicted.

According to the Centers for Disease Control and Prevention,[i] the major causes of traumatic brain injury include:

- **Falls** are the leading cause of brain injury at 40.5% of cases. Falls are a disproportionately common cause of TBI in children under age 15 (55%) and adults age 65 and older (81%), according to the CDC.
- **Unintentional blunt trauma** causes 15.5% of TBI. This includes being hit by or struck against a person or object.

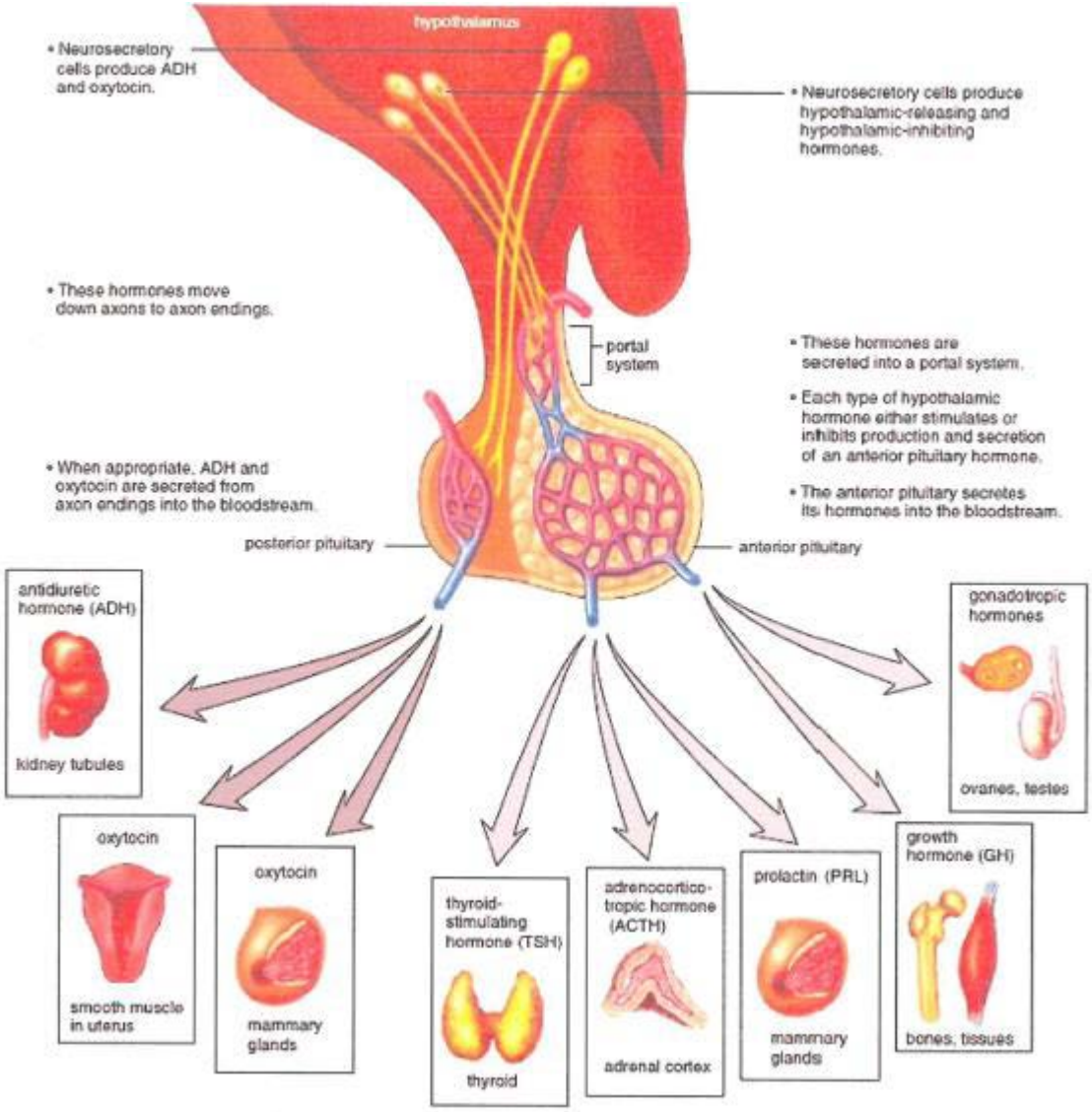
- **Motor vehicle collisions,** including car, truck and motorcycle accidents, are third at 14.3% of all TBI. However, vehicle crashes are a disproportionate cause of TBI-related deaths, at 26%.
- **Assaults** cause 10.7% of TBI. According to the CDC figures, most of those victims are between 15 and 44 years old.
- **Other and unknown causes** account for the remaining 19% of TBI.



Most of the traumatic brain injuries that occur every year are relatively mild injuries commonly called concussions. However, no injury to the brain is truly minor, and research is indicating that even seemingly mild concussions can have serious long-term implications for the victim, including pituitary dysfunction.

About the Pituitary Gland

Located at the base of the brain, the pituitary gland makes and stores many hormones that direct processes throughout the body, including stimulating other glands to produce other hormones – this is why it's often called the "master gland."



Hormones produced and stored by the pituitary gland include:[ii]

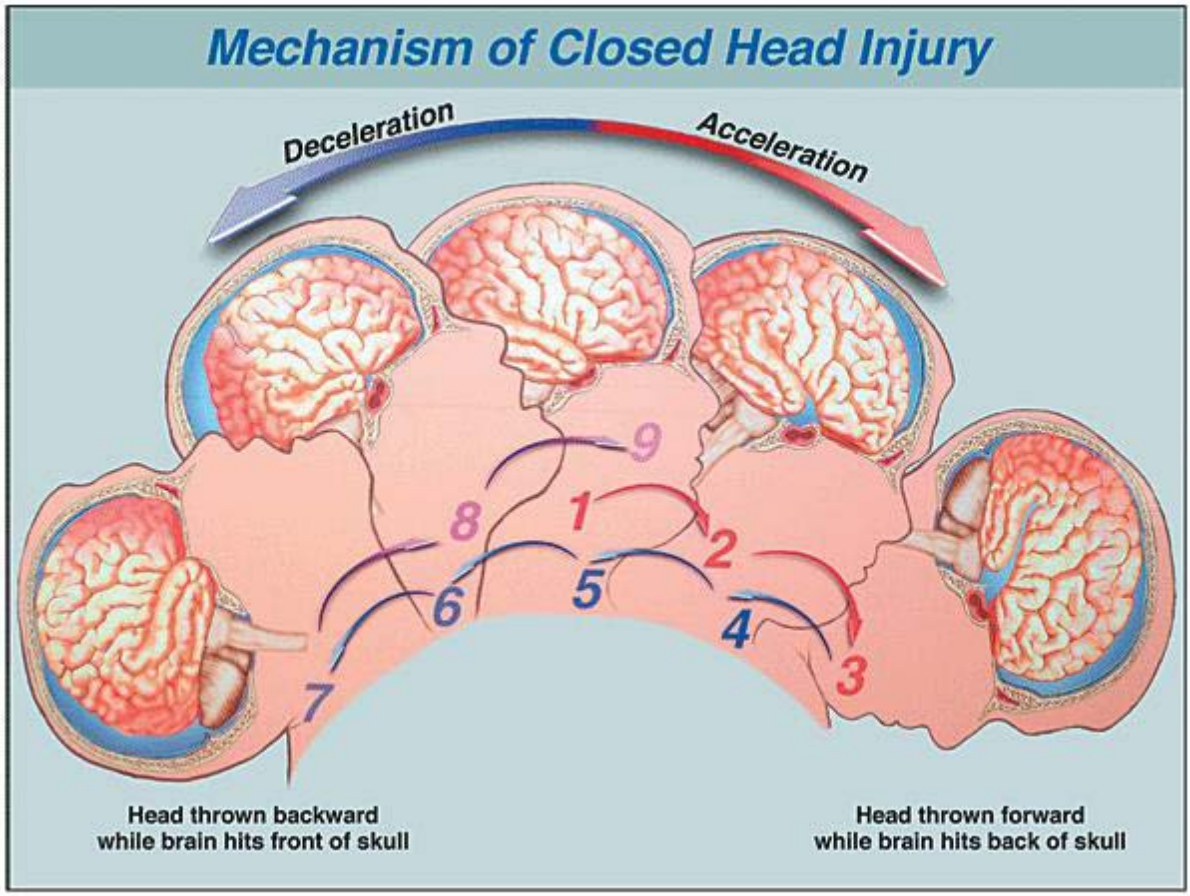
- **Prolactin,** which affects sex hormone levels in both women and men and stimulates breast milk production after childbirth in women. Prolactin levels also affect fertility.
- **Growth hormone (GH),** which not only stimulates growth in childhood but also helps adults maintain healthy body composition and well-being. Proper levels of growth hormone help adults maintain muscle mass and bone mass.
- **Adrenocorticotropin (ACTH),** which stimulates the adrenal glands to produce cortisol – a "stress hormone" that helps to maintain blood pressure and blood sugar levels.
- **Thyroid-stimulating hormone (TSH),** which, as its name implies, causes the thyroid gland to produce hormones that regulate the metabolism, energy balance, growth and nervous activity.

- **Luteinizing hormone (LH),** which helps men to produce testosterone and stimulates ovulation in women.
- **Follicle-stimulating hormone (FSH),** which stimulates sperm production in men and estrogen and egg development in women. Both FSH and LH are essential to the proper functioning of the ovaries and testes.
- **Antidiuretic hormone (ADH), or vasopressin** regulates water balance in the body.
- **Oxytocin** may play a role in helping labor to progress, and it causes milk to flow during breastfeeding.

Because the pituitary gland plays such an essential role in the body, it is well-protected against direct trauma. Specifically, it sits inside a saddle-like depression in the skull called the "sella turcica" (literally the "Turkish seat"), surrounded by bone. A narrow stalk connects the pituitary gland with the brain.

Mechanism of pituitary injury during a TBI

While the pituitary gland itself is protected against trauma, the pituitary stalk represents a relatively weak point. In a closed-head injury, the brain moves forward and backward inside the skull, constrained by the places where it is tethered to the base of the skull.



In an important 2005 study entitled "Deformation of the human brain induced by mild acceleration,"[iii] researchers identified those areas of the brain that bear the most pressure from this type of injury. Because the base of the brain near the pituitary gland is one of the places where the brain is tethered to the skull, it absorbs much of the impact in the event of a traumatic brain injury.

In short, the brain moves forward and backward, the pituitary gland stays secure in the sella turcica, and the pituitary stalk is caught in between. This can cause the stalk to stretch, twist and tear, breaking the blood vessels that supply blood to the pituitary gland. With the blood supply compromised, portions of the pituitary can become necrotic and stop functioning.

Young victims are particularly vulnerable to this sort of pituitary injury because, during adolescence, the pituitary gland tends to be quite plump due to high hormone levels. There is less room for the pituitary to move inside the sella turcica, which means more strain on the pituitary stalk. However, even in older victims, the pituitary stalk remains vulnerable to damage.

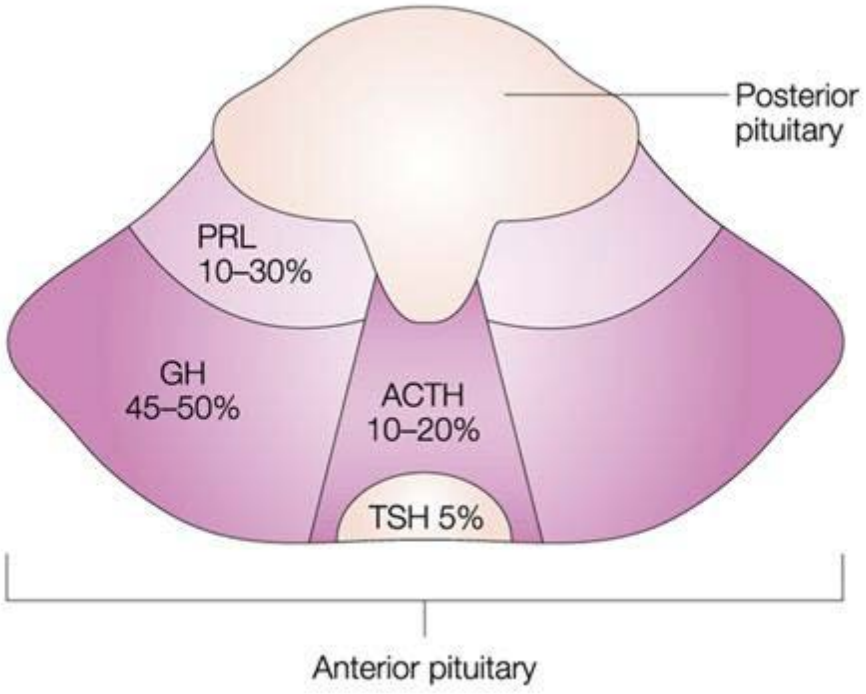
Study	Year	No. of Pts.	Months Post-TBI (median)	% PTHP
Kelly *et al.*	2000	22	3-276 (26)	37
Lieberman *et al.*	2001	70	1-276 (13)	69
Bondanelli *et al.*	2004	50	12-64	54
Agha *et al.*	2004	102	6-36 (17)	28
Popovic *et al.*	2004	67	12-264	34
Aimaretti *et al.*	2005	70	12	23
Leal-Cerro *et al.*	2005	99	>12	25
Schneider *et al.*	2006	70	12	36
Tanriverdi *et al.*	2006	52	12	51
Herrmann *et al.*	2006	76	5-47	24
Bushnik *et al.*	2007	64	>12	90
Klose *et al.*	2007	104	10-27 (13)	15
Tanriverdi *et al.*	2008	30	36	30
Wachter *et al.*	2009	55	NR	25

The above table summarizes 14 studies on hypopituitarism in traumatic brain injury victims, with the far-right column indicating the percentage of patients who experienced pituitary dysfunction following a TBI. Even the studies on the low end of the range indicate that 15 to 20

percent of TBI result in pituitary dysfunction, and those studies are in the minority. The majority of this research indicates that 30 to 50 percent of TBI victims have also sustained a pituitary injury, and while the above data focuses on studies done through 2009, more recent studies continue to confirm the above results that 30 to 50 percent of traumatic brain injuries have a pituitary damage component.

As there are 2.5 million brain injuries resulting in emergency room visits every year – not to mention potentially many more that go undetected – there are likely hundreds of thousands or even millions of victims nationwide on an annual basis.

Certain portions of the pituitary gland are more vulnerable to injury than others. Cells located in the lateral "wings" of the pituitary are particularly exposed because they depend on a single source of blood, which is easily damaged after a closed head injury. The following graphic shows which types of hormone-secreting cells are most vulnerable.



As such, in nearly half of pituitary injuries, the victim suffers reduced levels of growth hormone (GH), the consequences of which will be discussed below. Other potential symptoms of pituitary injury include loss of hormones that promote fertility (leading to sterility) and loss of insulin production (leading to traumatically induced diabetes).

Low hormone levels and TBI patients

Deficiencies of growth hormone and other hormones such as testosterone in TBI patients can have significant long-term implications for the patient's health. Because the hormones

produced in the pituitary gland control so many processes within the body, possible symptoms include:

- Fatigue
- Difficulty concentrating
- Emotional changes
- Lack of motivation
- Feelings of isolation
- Sterility
- Reduced body mass
- Increased abdominal fat mass
- Reduced bone mass
- Reduced muscle mass
- Reduced oxygen uptake
- Higher incidence of hypertension
- Increased cardiovascular mortality
- Increased risk of diabetes

In most cases, these symptoms can be alleviated by replacing the deficient hormones.[iv] Although hormone replacement therapy does not bring every patient back to pre-injury levels, there is little question that most patients have improved overall quality of life. Moreover, replacing those deficient hormones can reduce the risk of potentially life-threatening complications.

Challenges for patients with pituitary dysfunction

One of the more notable findings from the studies referenced previously is that hormonal deficiencies resulting from a pituitary injury may not become apparent for up to a year after the time of injury. This may be because the pituitary gland works particularly hard after the injury to replace the lost hormones, but can only do so for a limited period of time.

The main reason why pituitary injuries often go undetected is the delayed onset of symptoms. Another is that symptoms of pituitary injury are easily confused with other medical conditions, including traumatic brain injury. The cognitive symptoms of hormonal deficiencies, such as fatigue, lack of motivation, feelings of loneliness, emotional changes and difficulty concentrating, are also classic TBI symptoms. Since it is usually obvious that a patient has sustained a head injury, doctors may not even consider the possibility that pituitary dysfunction is to blame for some or all of the patient's symptoms.

Finally, while an MRI is a reliable way to detect damage to the brain itself, MRI scans are normally not able to detect damage to the tiny blood vessels in the pituitary stalk that supply blood to the pituitary gland. This means that, in many cases, patients have symptoms consistent with a moderate to severe TBI – symptoms that are actually caused by pituitary

dysfunction – but the MRI shows only a mild TBI. Too many of these patients are told that they are "faking" their symptoms or that they have an unrelated psychological condition, such as depression.

Long-term costs and legal rights for pituitary patients

Because of the nature and cost of pituitary injuries as well as traumatic brain injuries, patients who are suffering pituitary dysfunction after a head injury may benefit greatly from having experienced legal counsel.

Many traumatic brain injuries are caused by the negligence of people other than the patient. For instance, nearly 15 percent of TBI are sustained in vehicle accidents, which normally lead to a personal injury claim against an at-fault driver or sometimes another negligent party, such as a vehicle manufacturer. 40 percent of TBI are sustained due to falls, which again may lead to a personal injury claim against the owner, manager or caretaker of a property who failed to maintain safe premises. In cases where a TBI with pituitary damage is sustained during an assault, the victim may have a negligent security claim against the owner or manager of the property where the assault took place. When brain injuries are sustained during athletic activities such as football and other contact sports, the school system or athletic league that oversees the event may be held liable.

Legal representation can make a substantial difference for these patients because of the long-term cost of treating pituitary dysfunction. Hormone replacement therapy is a costly medical procedure; for instance, treatment with human growth hormone (HGH) normally costs $1,000 to $1,200 monthly, and the patient will need treatment until age 60. For a 25-year-old victim, the cost of such treatment alone may be over $500,000. Even those substantial medical expenses are only part of the story, as many victims may find their careers curtailed by lack of energy and personality changes, leading to claims for lost future income. Moreover, there are non-economic losses to consider, such as the devastation experienced by a patient who wanted to have children but was rendered sterile due to the injury. In some cases, spouses and family members of victims may be able to claim damages (financial compensation) for loss of consortium; that is, the loss of care, companionship and intimacy that the injured person is no longer able to provide.

Because the connection between brain injury and pituitary dysfunction is still gaining traction in the medical community, an attorney can play an important role in the patient's treatment as an advocate for their client's needs. A lawyer may be able to recommend that the client be screened for hormonal deficiencies which can reveal a pituitary injury. Just as significantly, insurance companies are rarely willing to pay out the six- and seven-figure settlements that pituitary injury victims may need to rebuild their lives after an injury. An experienced attorney familiar with the mechanism and consequences of brain injury and pituitary dysfunction can represent those patients in negotiations with the insurance company or at trial.

Conclusion

Pituitary injury represents a significant problem for the millions of people nationwide who sustain traumatic brain injuries. Because of the anatomy of the pituitary gland and its location as a main tethering point for the brain, the pituitary stalk is particularly vulnerable to twisting, stretching and tearing during a closed-head injury. This can compromise blood flow to certain portions of the pituitary, causing hormonal deficiencies, most commonly growth hormone deficiency.

Research indicates that between 30 and 50 percent of brain injury patients may have some level of pituitary dysfunction, yet it is often difficult for those patients to access the treatment they need. In many cases, pituitary dysfunction goes undetected because of the delayed onset of symptoms and because many of those symptoms can be attributed to classic TBI or with an unrelated psychological condition. An experienced legal advocate for the patient can make the case for the testing needed to confirm pituitary damage, and can help the patient recover full compensation for the expense of hormone replacement therapy and other losses due to the injury.

While further research is needed to understand the full impact of pituitary injuries on patients, particularly young patients, there is enough data available today to provide a high quality of life for most victims. It is the responsibility of the legal and medical communities to provide these patients with the quality of care and advocacy they need.

For more information

Contact Nelson Langer Engle, PLLC ("NLE Law"), a Washington law firm with extensive experience representing victims of traumatic brain injury and other long-term, catastrophic injuries. The firm has offices in Seattle, Snoqualmie and Tacoma, WA.

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[i] Centers for Disease Control and Prevention, “TBI: Get the Facts” https://www.cdc.gov/traumaticbraininjury/get_the_facts.html

[ii] Hormone Health Network, “Pituitary Overview” http://www.hormone.org/diseases-and-conditions/pituitary/overview

[iii] Bayly et al, J. Neurotrauma, 2005 August;22(8):845-846.

[iv] Gordon, Mark. “Post Traumatic Brain Injury Hormonal Deficiency Syndrome.” https://www.worldhealth.net/pdf/Gordon_Thera10.pdf