Gunshot Wound Head Trauma

March, 2011

In the past 20 years, there has been an increase in the incidence of head injuries caused by gunshot wounds. Gunshot wounds to the head have become the leading or second leading cause of TBI in many urban areas in the U.S. due in part to a surge in gang violence and overall homicide rates. Other cases involve suicide and unintentional accidents.

Suicide-related gunshot wounds to the head are associated with a very high mortality rate and severe disability in the few who survive. There is a greater chance of death and poorer outcome for victims with TBIs caused by self-inflicted gunshot wounds than victims injured by gunshot wounds that are accidental or delivered in an assault.

A wound in which the projectile breaches the cranium but does not exit is referred to as a penetrating wound, and an injury in which the projectile passes entirely though the head, leaving both entrance and exit wounds, is referred to as a perforating wound.

U.S. Statistics

- Twelve percent of all TBIs are attributed to firearms; in people ages 25-34, firearms are a leading cause of TBI.
- The incidence of gunshot-related, fatal TBI is higher among men than women, and more prevalent among African Americans than whites.
- Gunshot wound head trauma is the cause of an estimated 35 percent of all deaths attributed to TBI.
- Gunshot wound head trauma is fatal about 90 percent of the time, with many victims dying before arriving at the hospital.
- For victims who survive the initial trauma, about 50 percent die in the emergency room.
- About 50 percent of surviving patients will suffer from seizures and require anti-epilepsy medication.

Sources: eMedicine, Traumatic Brain Injury (TBI) - Definition, Epidemiology, Pathophysiology, 2009, and *Penetrating Head Trauma, 2009.*

New York-Presbyterian Hospital, Cranial Gunshot Wounds

University of California, Los Angeles Neurosurgery, Cranial GunShot Wounds

Surgical Treatment

Gunshot wound head trauma patients are aggressively resuscitated upon initial arrival at the hospital. If blood pressure and oxygenation can be maintained, an urgent CT scan of the brain is obtained. The decision to proceed with surgical treatment of the gunshot wound is based on these factors:

- The level of consciousness (GCS)
- The degree of brainstem neurological function
- CT scan findings.

If patients are deeply comatose with minimal evidence of brainstem function and no evidence of an intracranial hematoma that might be causing the coma, a fatal outcome is nearly certain. If a hematoma is confirmed by CT scan, an emergency craniotomy and clot evacuation may be performed. It is common for pressure to build up within the skull, so a craniectomy (a procedure in which a portion of the skull is temporarily removed) is also often performed.

Outcome

The main cause of death at the scene is usually blood loss – if a bullet damages key blood vessels and there is not enough time to stop the bleeding, the victim will bleed to death. If the victim survives the initial blood loss, the issue becomes the increasing pressure inside the skull. If the bullet itself goes through the brain, there is injury from both the direct penetration of the brain, and from transmission of a pressure wave from the high-velocity projectile travelling through the brain tissue. Both bleeding and damage from this pressure wave result in brain swelling, which can also lead to death.

Contributing Factors

- The bullet entry and/or exit
- The areas of the brain damaged by the trauma
- Degree of fragmentation of the bullet
- Caliber of the bullet and type of weapon
- Range of the gunshot wound (distance between the gun and the victim)
- Timeliness of receiving proper treatment
- The victim’s age and general health
- Initial GCS score
- Reactivity and dilation state of pupils
- Status of brainstem reflexes
- Blood pressure
- Oxygenation state right after injury

Understanding the trajectory of the bullet path is important in determining prognosis. The brain is divided into two hemispheres, made up of four lobes each, with each lobe providing different functions. Additionally, there are deeper parts of the brain that house many connections, controlling basic body and brain functions. The cerebellum in the back lower part of the brain is related to motor coordination. Finally, the brainstem connects the upper portion, or "thinking" portions of the brain to the spinal cord. Outcome is poorer for those with extensive bullet tracts, those that cross the deep midline structures of the brain, or those that involve the brainstem. A bullet that damages the patient's right hemisphere can leave the victim with motor and sensory impairments on the left side, and vice versa. Many other functions such as cognition, memory, speech, and vision are controlled by both sides of the brain. As a result, damage to one hemisphere can leave a person impaired but still able to perform these functions at some level,

depending on which lobes of the brain are damaged. Because each hemisphere is divided into four lobes, the "best-case scenario" is a more superficial injury limited to one hemisphere and a single lobe, limiting the functional impairments caused by the trauma.

The first week or two after trauma is the acute and critical care stage. After that, the extent and speed of recovery depend on how much tissue was damaged, the degree of swelling and pressure inside the head during the acute stage, as well as the functional consequences of the damage. Intensive rehabilitation may be necessary to help survivors regain some of their functions or to adapt to permanent deficits. Neurological recovery is measured in terms of several months or even years.