Traumatic Brain Injury—The Platinum 10 and the Golden Hour: An Interdisciplinary Approach

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Traumatic brain injury (TBI) is a leading cause of death and disability in the United States, accounting for nearly 2.5 million TBI-related hospitalizations, emergency department (ED) visits, and deaths.[12] Primary and secondary brain injury are terms used to categorize the processes that occur when a patient suffers head trauma. Primary brain injury occurs when the physical structures of the brain are displaced during the initial impact, primary brain injury occurs.

LEARNING OBJECTIVES

- List the traumatic head and spinal injury procedures
- Detail the conditions requiring TBI treatment
- Evaluate the hand-off process between the EMT, the ER and the perioperative team for a traumatic brain injured patient
- Describe the steps the CST needs to be aware of when case planning for a TBI patient
- Explain the Golden Hour and Platinum 10 Minutes

A complex array of inflammatory, excitotoxic, oxidative stress, metabolic, vascular, and mitochondrial mechanisms are activated in the first hours after injury, and each progresses to initiate further injury.[6] Secondary brain injuries are caused by chemical, cellular, and perfusion damage that develops minutes to hours after the initial impact.[6] These secondary injuries could be avoided if proper initial trauma care is provided.

Excellence in Prehospital Injury Care (EPIC) was created in 2011 by the University of Arizona in collaboration with the Arizona Department of Health Services as an EMS-centered traumatic brain injury project. This project aimed to develop clear, field-ready guidelines that would make a significant difference in the lives of traumatic head injury victims. Despite advances in medical science and vehicle safety, the number of TBI cases in the US continues to rise, with nearly 2.8

million cases reported yearly.[12] The aging population in the United States, and the increased use of blood-thinning medications, significantly contribute to this shift.[3] In 2010, the total cost of TBI in the US was estimated to be $76.5 billion.[4]

ASSESSMENT AND MANAGEMENT

Controlling oxygen saturation and ventilation may benefit from endotracheal intubation. However, because many TBI patients are combative or have intact protective airway reflexes, rapid sequence intubation (RSI) may be required to achieve intubation. RSI may prevent abrupt changes in oxygen saturation, blood pressure, and intracranial pressure in addition to removing protective airway reflexes.[1] Pretreatment for RSI is debatable and may worsen hypotension.

Emergency medical systems provide the trauma care system with the earliest opportunity to initiate resuscitation and rapidly transport patients to definitive care facilities. Because prehospital trauma care and priorities are time-driven, understanding the relationship between time and outcomes is critical for identifying opportunities to optimize prehospital care and improve trauma outcomes.[1] Survival after severe trauma is more than just a matter of quick rescue time; it is also a matter of well-utilized rescue time, which includes performing vital measures in the prehospital setting. This includes rescue teams identifying the severity of injuries in the most severely injured patients in critical condition more quickly than in less severely injured patients and planning their interventions accordingly.[9]

THE GOLDEN HOUR AND PLATINUM 10 MINUTES

The term "golden hour" is frequently used in trauma to refer to the fact that an injured patient has 60 minutes from the injury time to receive definitive care, after which morbidity and mortality rise steeply. The "platinum 10 minutes" concept, which is analogous, places a time constraint on the prehospital care of the seriously injured patient. Before transport to definitive care at a trauma center, no patient should have more than 10 minutes of scene-time stabilization by the prehospital team prior to transport to definitive care at a trauma center. Trauma is a severe public health problem. In the United States alone, trauma accounted for 29.2 million emergency department visits and 39.5 million physician office visits in 2016.[1] Trauma is the leading cause of death in the US for those aged 46 and younger; trauma-related mortality has increased by 23% across nearly all age groups between 2010 and 2016.[5]

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Rapid assessment, imaging with a CT scan, and possibly neurosurgery are required for patients who have suffered a head injury. Time is the brain, and any delay increases the likelihood of disability or death. Transporting patients to trauma centers that provide neurological services, and activating teams at these centers as soon as possible, expedites the process of definitive care.

TBI can have a significant impact on an individual's physical, cognitive, and emotional well-being. It can cause long-term effects that persist well beyond the initial injury. Here is an overview of traumatic brain injuries, including their causes, symptoms, diagnosis, and treatment.

Causes: Traumatic brain injuries can result from a variety of causes, including motor vehicle accidents, falls, sports-related injuries, physical assaults, and explosive blasts. These events can cause direct impact or force to the head or body, leading to brain damage. The severity of the injury can range from mild, such as a concussion, to severe, such as a skull fracture or intracranial hemorrhage.

Symptoms: The symptoms of TBI can vary depending on the severity of the injury and the part of the brain affected. Common symptoms of mild TBI include headaches, dizziness, confusion, and memory problems. More severe TBI can cause loss of consciousness, seizures, and paralysis. Emotional and behavioral symptoms such as depression, anxiety, and irritability can also occur following TBI.

Diagnosis: Diagnosing TBI typically involves a comprehensive evaluation that includes a physical examination, neurological assessment, and imaging studies such as computed tomography (CT) or magnetic resonance imaging (MRI) scans. Doctors may also perform cognitive tests to

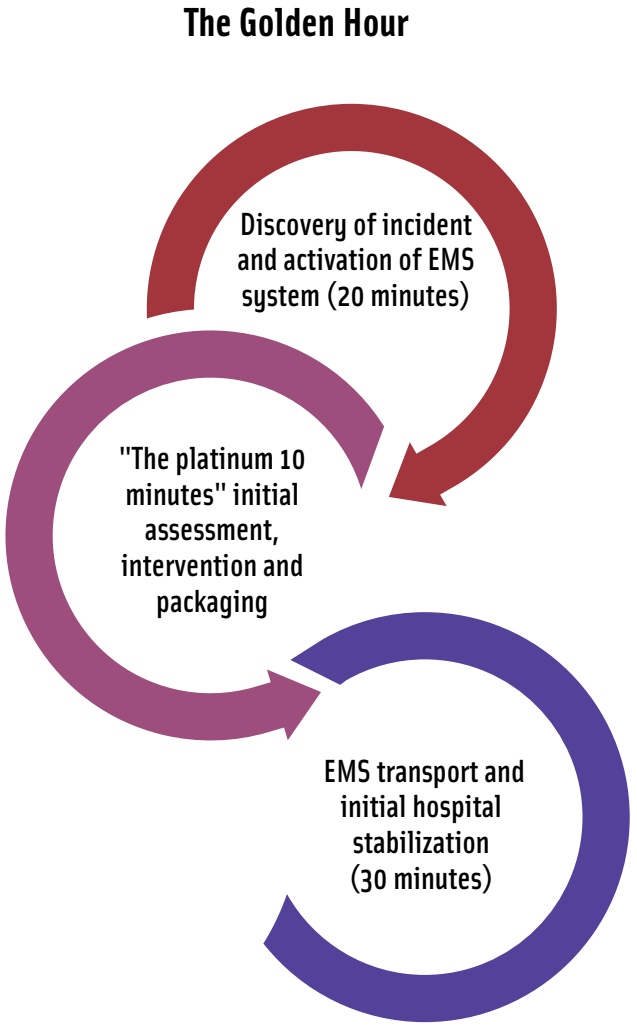
assess memory, attention, and other cognitive functions.

Treatment: The treatment for TBI varies depending on the severity of the injury. Mild TBI often requires rest and careful monitoring of symptoms, while more severe TBI may require surgery, medication, and rehabilitation. Rehabilitation may involve physical therapy to improve motor function, speech therapy to address communication difficulties, and cognitive therapy to improve memory and other cognitive functions. Additionally, mental health treatment may be necessary to address emotional and behavioral symptoms associated with TBI. Immediate surgery will be required for urgent and significant damage to the brain that cannot be corrected by nonsurgical treatments.[7]

THE HANDOFF PROCESS BETWEEN THE EMERGENCY MEDICAL TECHNICIAN (EMT), THE EMERGENCY ROOM DEPARTMENT, AND PERIOPERATIVE TEAM FOR A TRAUMATIC BRAIN INJURED PATIENT

The handoff process between the emergency medical technicians (EMT), the Emergency Room Department (ER) and the perioperative team for a TBI patient is a critical component of ensuring that the patient receives appropriate and timely care. The handoff process involves transferring the responsibility of the patient's care from the EMT and the ER team to the perioperative team, which includes CSTs, nurses, anesthesiologists, and surgeons. Here are the five key steps involved in the handoff process:

1. **Communication:** Effective communication is essential during the handoff process. The EMT should provide a detailed report [Situation, Background, Assessment & Recommendation (SBAR) or Mechanism, Injuries, Signs/Symptoms, and Treatment (MIST) report] of the patient's condition, including vital signs, level of consciousness, and any interventions that were performed during transport. The perioperative team should ask questions to clarify any uncertainties and ensure they clearly understand the patient's condition. Miscommunication during handoff can lead to as many as 80% of serious medical errors.[11]
2. **Assessment:** Once the patient arrives in the perioperative area, the perioperative team should perform a thorough evaluation to confirm the information provided by the EMT and ER teams to identify any additional injuries or concerns. It's important to note that the perception of handoff quality varies between healthcare providers, with 41% reporting "fair" to "poor" and only 35% reporting "very good" to "excellent."[10] This may include performing a physical examination, taking vital signs, and conducting diagnostic tests such as imaging studies to verify.
3. **Stabilization:** Depending on the patient's condition, the perioperative team may need to stabilize the patient before proceeding with further interventions. This may include administering medications to control pain or seizures or providing oxygen or other respiratory support.
4. **Planning:** Once the patient has been stabilized, the perioperative team should develop a plan of care based on the patient's condition and any diagnostic tests that



have been performed. This may involve consulting with other specialists, such as neurologists or intensivists, to develop a comprehensive care plan.

5. **Handoff documentation:** Throughout the handoff process, it is important to document all relevant information, including the patient's condition, interventions performed, and any concerns or questions. This documentation should be shared with perioperative team members and incorporated into the patient's medical record.

The handoff process between the EMT, the ED and perioperative teams can help to ensure that TBI patients receive timely and appropriate care, which can improve outcomes and reduce complications. Effective communication, thorough assessment, and careful planning are vital components of a successful handoff process for TBI patients.

DIFFERENT TYPES OF BRAIN AND SPINAL CORD INJURIES

Traumatic brain injury often occurs as a result of a severe sports injury or car accident. Each year, around 1.5 million Americans suffer a TBI, or those more than 200,000 US cases reported are injured badly enough to be sent to the hospital, resulting in more than 150 deaths each day.[8] It's worth noting that patients with TBI may have a combination of blunt and penetrating injuries, depending on the circumstances of the trauma. TBI's severity and specific manifestations can vary widely and require careful evaluation, diagnosis, and management by medical professionals.

Blunt trauma and penetrating trauma are two primary mechanisms of injury that can cause a TBI.

1. **Blunt Trauma:** Blunt trauma refers to injuries caused by a forceful impact or blow to the head, without any object penetrating the skull. It can result from various incidents such as falls, motor vehicle accidents, physical assaults, or sports-related injuries. Blunt trauma can cause TBIs through several mechanisms:
   a. *Concussion:* A concussion is a mild form of TBI caused by a sudden jolt or blow to the head. It disrupts normal brain function, leading to temporary symptoms such as confusion, headache, dizziness, and memory problems. Most concussions are considered mild and resolve within a few days to weeks.
   b. *Contusion:* A contusion is a more severe form of TBI characterized by bruising or bleeding within the brain tissue. It occurs when the brain strikes the inner skull during a blunt impact. Contusions can cause focal neurological deficits and may require medical intervention.
   c. *Diffuse Axonal Injury (DAI):* DAI is a severe form of TBI caused by the stretching, tearing, or shearing of nerve fibers (axons) within the brain. It typically occurs due to rapid acceleration or deceleration forces. DAI can result in widespread damage throughout the brain and often leads to significant cognitive, motor, and sensory impairments.
2. **Penetrating Trauma:** Penetrating trauma occurs when an object, such as a bullet, knife, or projectile, enters the skull and directly damages the brain tissue. Penetrating injuries often cause localized damage and can result in the following:
   a. *Intracerebral Hemorrhage:* Penetrating trauma can cause bleeding within the brain, leading to the formation of a hematoma. Depending on the location and severity, intracerebral hemorrhages can have severe consequences and may require surgical intervention.
   b. *Open Skull Fracture:* An open skull fracture occurs when a penetrating object breaks through the skull. These injuries carry an increased risk of infection and require immediate medical attention. Additionally, they can cause both focal and diffuse brain injuries.
   c. *Foreign Body:* A penetrating object may sometimes remain lodged in the brain. This foreign body can cause ongoing damage and necessitates surgical removal to prevent complications.

CONDITIONS THAT REQUIRE SURGERY

Skull fractures: Four significant types of skull fractures that need surgery include linear skull fractures, diastatic skull fractures, depressed skull fractures, and basilar skull fractures.

Hydrocephalus: Is a condition occurs when cerebrospinal fluid (CSF) builds up in the ventricles (cavities that produce CSF) situated deep in the brain.

Intracerebral hemorrhage: A life-threatening emergency that deprives the brain of oxygen and blood supply and occurs because of bleeding in the brain tissue requiring immediate treatment.

Hematomas: A blood collection that accumulates within the skull outside the blood vessels. Intracranial hematoma

(ICH) is a potentially life-threatening head injury. The various ICHs include epidural hematoma, subdural hematoma, diffuse axonal injury (DAI), and contusion or intracerebral hematoma.

THE ROLE OF THE CERTIFIED SURGICAL TECHNOLOGIST IN CASE PLANNING FOR A TBI PATIENT

The role of the Certified Surgical Technologist (CST) in case planning for a TBI patient is critical for ensuring safe and effective surgical care. The CST is a surgical team member responsible for preparing the operating room and equipment, assisting the surgeon during the procedure, and maintaining a sterile field. Here are some of the ways in which the CST can contribute to case planning for a TBI patient:

1. **Preoperative planning:** The CST can work with the surgical team to develop a plan for the surgical procedure based on the patient's specific condition and needs. This may include identifying any specialized equipment or instrumentation that may be needed, checking the surgeon's preference card, ensuring that the appropriate sterile supplies are available, and coordinating with surgical team members to ensure all necessary preparations are completed before the procedure begins.
2. **Patient positioning:** The CST is responsible for confirming the positioning of the patient on the operating table in a way that is safe and comfortable for the patient, while also providing the surgeon with optimal access to the surgical site. This may involve special considerations such as ensuring that the patient's head and neck are properly supported and that there is sufficient clearance for any monitoring or diagnostic equipment that may be needed during the procedure.
3. **Instrument selection:** The CST can assist the surgeon in selecting and preparing the appropriate surgical instruments. This may involve identifying specialized instruments that are designed specifically for TBI procedures or ensuring the instruments used are appropriately sized and configured for the patient's anatomy, and double checking the surgeon preference card to verify all available equipment is ready.
4. **Sterile technique:** The CST is responsible for maintaining a sterile field to minimize the risk of infection. This involves ensuring that all sterile supplies and equipment are properly prepared and that the surgical team follows strict sterile technique throughout the procedure. For TBI patients, this may involve additional precautions, such as using specialized draping materials or taking extra care to avoid surgical site contamination.

Effective communication, thorough assessment, and careful planning are vital components of a successful handoff process for TBI patients.

SURGICAL INSTRUMENTATION

The CSTs knowledge of surgical instrumentation used in TBIs is critical and can impede or enhance the outcome of the case. Surgical instruments used in TBI procedures can vary depending on the specific type and severity of the injury, as well as the surgical approach being used. However, several types of surgical instruments commonly used in TBI procedures, including:

1. **Cranial drills:** Cranial drills are specialized surgical instruments used to create openings in the skull for accessing the brain. These drills may be used in TBI procedures to relieve pressure on the brain, remove blood clots, or repair damage to the skull.
2. **Bone rongeurs:** Bone rongeurs are surgical instruments that remove small pieces of bone from the skull. In TBI procedures they create a larger opening in the skull or remove any bone fragments that may be causing pressure on the brain.
3. **Neurovascular clamps:** Neurovascular clamps are specialized surgical instruments used to temporarily occlude blood vessels during surgery. In TBI procedures they control bleeding or they isolate a specific area of the brain during the procedure.
4. **Microsurgical instruments:** Microsurgical instruments are specialized surgical instruments used in procedures requiring a high degree of precision and control. In TBI

procedures they may be used to repair damaged blood vessels or nerve tissue, to remove small tumors or other abnormalities from the brain.

5. **Intracranial pressure monitors:** Intracranial pressure monitors are specialized instruments used to measure the pressure inside the skull during surgery. In TBI procedures they help guide the surgical approach and monitor the patient's response to treatment.

TRAUMATIC HEAD AND SPINAL INJURY PROCEDURES

Traumatic head and spinal injuries can vary widely in severity, and the procedures undertaken depend on the specific nature and extent of the injury. Here are some standard procedures and potential complications:

Head Injury Procedures:

1. **Craniotomy:**
   - **Description:** This surgical procedure involves the removal of part of the skull to access the brain
   - **Complications:** Infection, bleeding, swelling, neurological deficits, seizures, and long-term cognitive impairments
2. **Intracranial Pressure Monitoring:**
   - **Description:** Involves placing a device to monitor pressure inside the skull
   - **Complications:** Infection, bleeding, damage to surrounding structures, and inaccurate pressure readings
3. **Ventriculostomy:**
   - **Description:** A catheter is inserted into the brain's ventricles to drain excess cerebrospinal fluid
   - **Complications:** Infection, bleeding, damage to brain tissue, and blockage of the catheter

Spinal Injury Procedures:

1. **Spinal Fusion:**
   - **Description:** Involves joining two or more vertebrae to stabilize the spine
   - **Complications:** Infection, failure of fusion, nerve damage, blood vessel injury, and chronic pain
2. **Decompressive Surgery:**
   - **Description:** Removing parts of the spine to relieve pressure on the spinal cord or nerves
   - **Complications:** Infection, bleeding, spinal fluid leaks, neurological deficits, and instability
3. **Vertebroplasty/Kyphoplasty:**
   - **Description:** These procedures involve injecting bone cement into fractured vertebrae to stabilize them
   - **Complications:** Infection, cement leakage, nerve injury, and worsening of fractures
4. **Discectomy:**
   - **Description:** Removal of part or all of a spinal disc to relieve nerve pressure
   - **Complications:** Infection, bleeding, nerve injury, and recurrent disc herniation

It's essential to understand that surgical approaches and procedural complications vary based on factors such as the patient's overall health, the severity of the injury, and the success of the surgical intervention. Additionally, advances in medical technology and surgical techniques may contribute to improved surgical outcomes and reduced risks over time.

CONCLUSION

The "Golden Hour" and the "Platinum 10 minutes" are critical timeframes in the management of traumatic brain injury (TBI) patients. The Golden Hour refers to the first hour after a traumatic injury, during which immediate and appropriate medical care can significantly improve a patient's chances of survival and recovery. The primary goal of the Golden Hour is to provide the necessary medical interventions to stabilize the patient's vital signs and prevent further damage to the brain.

The Platinum 10 minutes refer to the first 10 minutes after a patient's arrival at a medical facility. During this time, medical professionals should assess the patient's airway, breathing, and circulation (ABCs) to identify any life-threatening conditions and start appropriate interventions. This early assessment is critical in identifying and treating conditions that can quickly lead to further brain injury, such as hypoxia or hypotension.

The Golden Hour and the Platinum 10 minutes are are essential in managing of TBI patients because early intervention can significantly improve patient outcomes. Delayed or inadequate care during these critical timeframes can lead to worsened brain injury and potentially permanent disabilities or even death.

In summary, the Golden Hour and the Platinum 10 minutes are timeframes during which immediate and appropriate medical care can significantly improve a TBI patient's chances of survival and recovery. Medical professionals must prioritize these timeframes in the managing of TBI patients to ensure the best possible outcomes.

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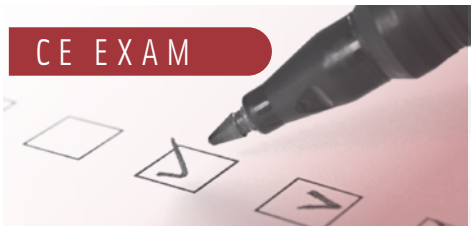

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1. **The term golden hour is used in trauma to refer to the fact that an injured patient has ___ from the injury time to receive definitive care after which morbidity and mortality rise steeply.**
   a. 30 minutes
   b. 60 minutes
   c. 120 minutes
   d. 180 minutes

2. **What are some of the conditions that require surgery for a head injury?**
   a. Hydrocephalus
   b. Skull fractures
   c. Hematomas
   d. All of the above

3. **What is used in TBI procedures to temporarily occlude blood vessels?**
   a. Neurovascular clamps
   b. Cranial drills
   c. Microsurgical instruments
   d. Intracranial pressure monitors

4. **The platinum 10 minutes concept places a time constraint on the _____ of the seriously injured patient.**
   a. Prehospital care
   b. Intraoperative care
   c. Postoperative care
   d. All of the above

5. **Diagnosing TBI involves a comprehensive evaluation that includes:**
   a. Physical examination
   b. Imagining studies
   c. Neurological assessment
   d. All of the above

6. **Which procedure involves injecting bone cement into fractured vertebrae to stabilize them?**
   a. Discectomy
   b. Spinal Fusion
   c. Vertebroplasty/Kyphoplasty
   d. Craniotomy

7. **Common symptoms of mild TBI include:**
   a. Headaches
   b. Seizures
   c. Paralysis
   d. All of the above

8. **There are five key steps involved in the handoff process for the TBI patient. Which is the second step?**
   a. Communication
   b. Assessment
   c. Stabilization
   d. Planning

9. **What surgical procedure requires a catheter to be inserted into the ventricles of the brain to drain excess cerebrospinal fluid?**
   a. Craniotomy
   b. Intracranial Pressure Monitoring
   c. Ventriculostomy
   d. Spinal Fusion

10. **Microsurgical instruments are specialized surgical instruments used in TBI procedures to:**
    a. Repair damaged blood vessels
    b. Remove small tumors
    c. Remove bone fragments
    d. Both a and b

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