Traumatic Brain Injury
Pre-Hospital & Emergency Care

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So, how frequently are you going to be faced with a patient with a traumatic brain injury?

Epidemiology of Head Injury

- **7.5 million** head injuries reported per year in U.S.A.
- **1.5 million** of significant head injury per year
- A head injury occurs every **15 seconds**
- A patient dies of a head injury every **12 minutes**
- **50%** of all **trauma deaths** are associated with head injury
- **60%** of all **vehicular trauma deaths** are due to head injury

Therefore . . .

in recent years, more attention was directed to prevention and early management of head trauma.
Laws and Regulations have been enforced regarding:

- Speed Limits
- Traffic Violations
- Driving Under the Influence
- Use of Seat Belts
- Use of Helmets

Of course . . .
You can’t enforce “common sense”!!

Faster and Better Diagnostic Studies, that would eliminate any delay of treatment.
However, the most significant advancement was directed to:
- Advanced clinical training of **Paramedics** (first responders).
- Immediate transport to **Designated** Trauma Center for definitive care.
- Organization of “**Team**” approach.

**“Team Approach”**
- There is a very strong link between the pre-hospital care . . . the initial emergency room management . . . and the definitive management by a neurosurgeon in the ICU or the operating room.
- That “link” will definitely result in a better outcome of patients with traumatic brain injury . . . and it will definitely save lives.

**“Team Approach”**
- You should be aware that your intervention in the **first few minutes** at the scene . . . determines the patient’s **prognosis** . . . and his neurological condition at the time of discharge from the hospital.
Management of Traumatic Brain Injury

Then & Now

On November 22, 1963

Dallas, Texas
On January 8, 2011

Tucson, Arizona
July 3, 1976
3 a.m.

1st notification of patient with TBI

“You have an admission”!!

What do I do now?

This was exactly how I felt!!
I had **no** information regarding:
- The accident
- Patient’s condition at the scene
- Pre-hospital care
- Emergency room management

**No Imaging Studies**

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**Learning Lessons from History - CT**

- First CT machine
  - 9 days to scan an object
  - 21 issues to computer process information

- Sir Godfrey Hounsfield – Nobel prize speech 1979
  “When I investigated the advantages of CT scanning over conventional x-ray techniques, it became apparent that the conventional methods were not making full use of all the information that x-rays could give.”
So . . . the patient’s initial assessment and treatment started only . . . after the patient was moved to his bed in the hospital.

“Trauma Team” Model 1976

1. An Ambulance Its main function is to:
   Drive the patient to the hospital
   “Scoop and Run” approach

2. Emergency Room Start an IV
   Admit the patient to the hospital
   Assign the patient to a bed

3. Intern/Resident “Deal with it” On-call
   “Deal with it”

Management of Traumatic Brain Injury

Now
Pre-Hospital Care

What are the optimal objectives of pre-hospital care?

1. Initial neurological assessment.
2. Preventing “secondary” brain injury.
3. Maintain cerebral perfusion pressure.
4. Immediate transfer to a designated trauma center.

Initial Assessment

Mini-Neurological Exam

Level of Consciousness

- Lateralized Extremity Weakness
- Pupillary Function

Glasgow Coma Scale (GCS)

A. Eye-Opening Response
B. Best Motor Response
C. Verbal Response
Glasgow Coma Scale (GCS)

- GCS provides a quantitative measure of the patient’s level of consciousness.
- The GCS has a point system for each part . . . total of 15 points.
- A GCS of 7 or less indicates a severe head injury . . . and usually indicates a poor prognosis.

Increased Intracranial Pressure

- The final common pathway of head injuries is related to increased Intracranial Pressure . . . and . . . decreased cerebral perfusion.
  - Cerebral perfusion pressure = MAP - ICP
- Increased Intracranial Pressure may result in cerebral herniation . . . irreversible coma . . . or brain death.
- One of the late manifestations of cerebral herniation is fixed dilated pupil.

Fixed Dilated Pupil = Cerebral Herniation
Increased Intracranial Pressure

What are the clinical signs of possible Intracranial Hypertension?

- Decline in the GSC score of 2 points or more.
- Development of sluggish or non-reactive pupil.
- Development of hemi-paresis or hemiplegia.
- Cushing’s phenomenon.
  - Bradycardia
  - Hypertension

Emergency Treatment of Increased ICP

Unmonitored pt. with clinical signs of herniation:

- Elevate head of bed 30°
- Normal saline 100ml/hr.
- Intubate and hyperventilate (PCO2 26-30)
- Mannitol 20% 1.0-1.5mg/kg rapid IV infusion
- Foley Catheter
- CT scan and neurosurgical evaluation
Prevention of “Secondary” Brain Injury

“Do No Harm”

Avoid the Terrible H’s
Prevention of “Secondary” Brain Injury

What are the “Terrible” H’s?
- Hypoxia
- Hyperventilation
- Hypotension
- Hypovolemia
- Hemorrhage
- Hypo-osmolality
- Hydrocortisone (steroids)
- Hyponatremia

Hypoxia

- O2 saturation < 90% should be avoided.
- As with all trauma patients, the first priorities in patients with TBI are:
  A. Airway
  B. Breathing
  C. Circulation
- If patient has GSC of 8 or less . . . patient will need airway protection → Intubate.

Hyperventilation

- Hyperventilation is recommended as a temporary measure for the reduction of elevated Intracranial Pressure.
- Hyperventilate on the way to an acute intervention.
- Otherwise, Do Not Hyperventilate
Hypotension

- Systolic BP < 90 mm Hg should be avoided.
- Maintenance of adequate cerebral perfusion by maintaining a normal or even elevated blood pressure is one of the key principles in management of TBI.
- Hypoxia alone is much better tolerated than hypotension.
- Hypotension and Hypoxia are bad.

Hemorrhage

- Complex scalp wound may bleed sufficiently to develop shock.
- A compression dressing created with gauze pad and elastic bandage often provides satisfactory control of hemorrhage.

Hypo-Osmolality

- The strategy for fluid resuscitation of head injured patient is to maintain a normal intravascular volume and avoidance of hypo-osmolality, with the use of isotonic fluids.
- Hypertonic solution may be used to treat Hyponatremia.
Hyperosmolar Therapy

- Mannitol is effective in lowering ICP temporarily.
- Restrict Mannitol use (prior to ICP monitoring) to patients with signs of cerebral herniation or progressive neurological deficit.

Steroids

- The use of steroids is not recommended for improving outcome or reducing intracranial pressure (ICP).
- In patients with moderate or severe traumatic brain injury (TBI), high dose steroids is associated with increased mortality and is contraindicated.
- Do Not use steroids for TBI. Period.

Conclusion

- The outcome of traumatic brain injury is determined by:
  1. Early intervention at the scene.
  4. Immediate transfer to a designated trauma center, for definitive Neurosurgical intervention.
“Alteration of Consciousness”
is the
Hallmark of Traumatic Brain Injury

Thank You
Emergency Treatment of Increased ICP

- Un-monitored patient with clinical signs of herniation
  - Elevate head of bed 30°
  - Normal saline 100 ml/hr
  - Intubate and hyperventilate (pCO2 26-30)
  - Mannitol 20% 1.0 to 1.5 g/kg rapid IV infusion
  - Foley catheter
  - CT scan and neurosurgical evaluation
Mini-Neurological Examination

- Level of Consciousness
- Lateralized Extremity Weakness
- Pupillary Function

Glasgow Coma Scale (GCS)

A. Eye-Opening Response
   - Spontaneous 4 points
   - To Speech 3 points
   - To Pain 2 points
   - None 1 point

B. Best Motor Response

C. Verbal Response
Glasgow Coma Scale (GCS)

B. Best Motor Response
- Obeys 6 points
- Localizes 5 points
- Withdraws 4 points
- Decorticate Posture 3 points
- Decerebrate Posture 2 points
- No Movement 1 point

Glasgow Coma Scale (GCS)

C. Verbal Response
- Oriented 5 points
- Confused 4 points
- Inappropriate 3 points
- Incomprehensible 2 points
- None 1 point

GCS provides a quantitative measure of the patient’s level of consciousness.