Case Study
September 5, 2012 – Brandon McCarthy Oakland A’s baseball pitcher was struck on the right side of his head by a line drive (91 mph) off the bat of Erick Aybar of the Los Angeles Angels. (The player was thrown out at first base by the third baseman!!!)
He had a skull fracture, epidural hematoma, and brain contusion.

Epidural Hematoma
• Arterial bleed
• Middle meningeal artery tear due to skull fracture
• Between skull and dura
• Unconscious – conscious – unconscious

What’s the Challenge?
Epidural Hematoma
• Prevent Uncal Herniation
  • Ipsilateral dilated fixed pupil, decreased level of consciousness, contralateral paralysis
• Arterial bleeding
  • Surgery for burr holes and drain

Case Study (con’t)
• Two hours of emergency surgery was performed late that night.
• He was discharged 6 days later.

Case Study (con’t)
• He is now playing for the Arizona Diamondbacks
• In May, 2013 (8 months later) he was having dinner with his wife at a Phoenix restaurant and collapsed with a seizure.
• After an extensive examination at the Mayo Clinic he is now taking antiepileptic medication.
Guidelines for the Management of Severe TBI (2007)

• Joint venture
• Brain Trauma Foundation
• American Association of Neurological Surgeons
• Congress of Neurological Surgeons
• Joint Section on Neurotrauma and Critical Care

Levels of Evidence

• **Class I Evidence**
  - Derived from randomized controlled trials. However, some may be poorly designed, lack sufficient patient numbers, or suffer from other methodological inadequacies that render them Class II or III.

• **Class II Evidence**
  - Derived from clinical studies in which data were collected prospectively, and retrospective analyses that were based on reliable data. Comparison of two or more groups must be clearly distinguished. Types of studies include observational, cohort, prevalence, and case control. Class II evidence may also be derived from flawed RCTs.

• **Class III Evidence**
  - Derived from prospectively collected data that is observational, and retrospectively collected data. Types of studies include case series, data-bases or registries, case reports, and expert opinion. Class III evidence may also be derived from flawed RCTs, cohort, or case-control studies

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#1 Blood Pressure and Oxygenation

- **Level I:** Insufficient data
- **Level II:** Monitor BP, avoid SBP < 90mmHg
- **Level III:** Monitor Oxygenation, avoid O2 Sat < 90% or PaO2 < 60mmHg

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#2 Hyperosmolar Therapy

- **Level I:** Insufficient data
- **Level II:** Effect for control of increased ICP
  - Dose range 0.25gm/kg to 1gm/kg
  - Avoid SBP < 90mmHg
- **Level III:** Restrict mannitol use prior to ICP monitoring to patients with signs of herniation, neuro deterioration not attributable to extracranial causes

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#3 Prophylactic Hypothermia

- **Level I:** Insufficient data
- **Level II:** Insufficient data
- **Level III:** Not significantly associated with decreased mortality. Preliminary findings show greater decrease in mortality observed when target temperatures are maintained for more than 48 hours

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#4 Infection Prophylaxis

- **Level I:** Insufficient data
- **Level II:** Provide periprocedural antibiotics for intubation. Provide early tracheostomy.
- **Level III:** Avoid routine ventricular catheter exchange or prophylactic antibiotic use. Early extubation can be done.
#5 Deep Vein Thrombosis Prophylaxis

- Level I: Insufficient data
- Level II: Insufficient data
- Level III: Provide graduated compression stockings or intermittent pneumatic compression stockings, unless extremity injuries prevent their use. Continue use until patient is ambulatory.

#6 Indications for ICP Monitoring

- Level I: Insufficient data
- Level II:
  - Severe head injury and abnormal CT Scan
  - GCS 3-8 after CPR
  - Hematoma, contusion, edema, compressed basal cisterns
- Level III:
  - Severe head injury and normal CT Scan
  - Two or more: > 40yrs, unilateral/bilateral motor posturing, SBP < 90mmHg

#7 Intracranial Pressure Monitoring Technology

- Ventricular catheter and drainage system
  - Most accurate, low cost, reliable method
  - Can be recalibrated
- Parenchymal catheter
  - Cannot be recalibrated
  - Negligible drift
- Subarachnoid, subdural, and epidural
  - Less accurate

#8 Intracranial Pressure Thresholds

- Level I: Insufficient data
- Level II: Initiate treatment with ICP thresholds above 20 mmHg
- Level III: Combination of ICP, clinical, and CT findings should be used to determine need for treatment
  - Initiate treatment to lower ICP for thresholds 20 – 25 mmHg

#9 Cerebral Perfusion Thresholds

- Level I: Insufficient data
- Level II: Avoid CPP above 70mmHg
- Level III: Avoid CPP < 50mmHg

#10 Brain Oxygen Monitoring and Thresholds

- Level I: Insufficient data
- Level II: Insufficient data
- Level III: Jugular venous saturation <50% or brain tissue oxygen tension <15 mmHg are treatment thresholds
#11 Anesthetics, Analgesics, and Sedatives

- **Level I**: Insufficient data
- **Level II**: Prophylactic barbiturates to induce burst suppression EEG is not recommended
  - High dose barbiturates is recommended to control elevated ICP refractory to medical/surgical treatment in stable hemodynamic patient
  - Propofol is recommended for control of ICP

#12 Nutrition

- **Level I**: Insufficient data
- **Level II**: Should be fed to attain full caloric replacement by day 7 post-injury

#13 Antiseizure Prophylaxis

- **Level I**: Insufficient data
- **Level II**: Prophylactic use of phenytoin or valproate is **NOT RECOMMENDED** for preventing LATE post-traumatic seizures
  - Anticonvulsants are indicated to decrease incidence of early posttraumatic seizures within 7 days of injury.

#14 Hyperventilation

- **Level I**: Insufficient data
- **Level II**: PCO2 of 25mmHg or less is not recommended
- **Level III**: Hyperventilation is recommended as temporizing measure to reduce increased ICP
  - Avoid hyperventilation during first 24 hours.
  - Monitor oxygen delivery with SjO2 or PbrO2 if hyperventilation is used.

#15 Steroids

- **Level I**: Not Recommended

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**Case Study**

Mrs. W. is a 62 year old female with PMH significant for breast cancer. Her husband observed that she was confused in the morning and she went to walk to the bathroom and missed the door. She began to experience rhythmic contractions of her right side and was unable to speak.

What do you think is going on?
Seizure Statistics

- Affects almost 3 million Americans of all ages
- Estimated annual cost of $15.5 billion in direct and indirect costs
- Approximately 200,000 new cases occur/year
- 10% of the American population will experience a seizure in their lifetime
- 3% will develop epilepsy by age 75

Pathophysiology

- Seizure is due to
  - Overactivity of excitatory neurotransmitters
  - Underactivity of inhibitory neurotransmitters
- Seizures are an uncoordinated flow of electrical activity

Seizure Etiology

- Idiopathic (70% of all cases)
- “Essential” epilepsy - primarily genetic
- “Acquired” epilepsy
  - Trauma, CNS infection, tumors, cerebral vascular, alcohol withdrawal
- Other Causes
  - Fever, electrolyte imbalance, medications

Partial (Focal) Seizures

- 80% of people who have seizures
- Starts in only one part of the cerebral cortex
- Altered/no change in consciousness
- Develop into generalized seizure (Secondarily Generalized Seizure)

Simple Partial Seizure

- Hand may shake
- “Feel strange”
- Mouth may twitch uncontrollably
- Lasts up to 90 seconds
- Doesn’t affect consciousness (aware & alert)
- Auras before seizure
  - Dizzy, unusual feeling, smell, sound, or sight

Complex Partial Seizure

- Staring straight ahead, looking around
- Fidgeting with clothes
- Lip smacking
- Aimless wandering
- Pats or rubs arms repeatedly (automatisms)
- LOC is impaired (confused, no memory)
- Last 1-2 minutes
Generalized Seizures
- 20% of people who have seizures
- Begins in widespread fashion
- Sudden onset
- Loss of consciousness

Tonic – Clonic Seizure
- Entire cerebral cortex is involved
- Unconscious
- Tonic Phase and Clonic Phase
- Cry out – Ictal cry
- Incontinent
- Doesn’t feel, see, or remember anything during seizure
- Lasts 1 – 2 minutes

Myoclonic Seizures
- Layers of cerebral cortex affecting movement
- Generalized jerking of an extremity
- Less than 5 seconds
- Brief, easy to miss period of unconsciousness
- DO NOT LOSE CONSCIOUSNESS!!!
- Occur in clusters
- Post-cardiac arrest

Absence Seizures
- Brief loss of consciousness
- Staring or blanking out spells
- May exhibit rapid blinking, chewing, or aimless movements of head or limbs
- Last 2 - 15 seconds
- More often in children

Non-Convulsive Seizure
- Mental status change or subtle eye movement from baseline of at least 30-60" with continuous ictal discharges on EEG
- 30% of NICU patients in seizure
- 16% are TBIs
- 8% of patients in coma
- Monitor with continuous EEG for 24 hours
- Difficult to treat with AEDs
- Try phenytoin, lorazepam, or levetiracetam (Keppra)

Nonepileptic Seizures
- Looks like a seizure
- Treated on average 7 years for a seizure
- 70% are women (History of Trauma)
- Compare EEG tracing and audio-video monitoring
Status Epilepticus

- Continuous seizure
- Lasting at least 5 minutes “OR”
- Two or more discrete seizures between which there is incomplete recovery of consciousness
- Medical emergency
- 20% mortality rate

Case Study (con’t)

When Mrs. W. arrived in the ED, she continued to have seizure activity. What intervention(s) should be put into place?

Treatment of Status Epilepticus

Columbia University Protocol - 2006

First 5 minutes

<table>
<thead>
<tr>
<th>Time</th>
<th>Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-10 minutes</td>
<td>Ativan 4mg IVP over 2” Repeat in 5”</td>
</tr>
<tr>
<td>10 – 20 minutes</td>
<td>Fosphenytoin 20mg/kg IV at 150mg/minute Dilantin 20mg/kg (rate 50mg/min)</td>
</tr>
<tr>
<td>If persist, give one of the following</td>
<td>Versed, Propofol, Valproate, Phenobarbital</td>
</tr>
<tr>
<td>&gt; 60 minutes</td>
<td>Pentobarbital</td>
</tr>
</tbody>
</table>

Nursing/Medical Management

- Immediate Interventions
  - If aura....
  - Note time of onset....
  - Stay with patient, head-tilt, chin-lift
  - Turn patient on side
  - Move objects
  - Administer AEDs as ordered
  - PRN benzodiazepines
  - Airway management if needed

Ictal Assessment

- Responsiveness
  - Describe how you are feeling
  - Assess orientation (name, where are you?)
- Awareness
  - Give word/phrase to remember (color/object) “blue elephant”
- Language
  - Name an objects (pencil, watch)
- Motor Function
  - Stick out your tongue
  - Show me two fingers

Nursing/Medical Management

- After Seizure
  - Reorient patient, “what just happened?”
  - Ask about aura, “Can you remember the object?”
  - Assess postictal paralysis (smile, drift)
  - Test language (name object, “no ifs, ands or buts”)
  - Assess for injuries
  - Allow to rest, patient may be lethargic
  - Institute seizure precautions(siderails of bed are up, suction setup is available, and bed is kept in lowest position)
Case Study
(Robertson, L. (2001))

• A 36-year-old women presents to the emergency room with complaints of generalized weakness and inability to ambulate. She was reported to be in her normal state of health until approximately nine days earlier when she developed influenza symptoms with fever, chills and diarrhea.

Case Study (con’t)
• The day before admission to the ED she worked in the garden, went shopping and was back to her general state of health except for “post-flu weakness”
• At approximately 8PM she started to develop an increased fever with associated rigors.
• She had excessive perspiration and a mild headache that lasted for a couple of hours
• She was able to fall asleep

Case Study (con’t)
• She reported waking in the morning feeling fatigued. She had difficulty getting out of bed and walking to the bathroom. She reported feeling progressively weaker throughout the morning.
• Late in the morning she got out of bed and collapsed while walking to the kitchen.
• Her husband called 911 and she was taken to the hospital.

Case Study (con’t)
• What do you think is going on??
• Had the flu 9 days ago...
• Now fatigue with bilateral leg weakness

Ascending Guillian Barre Syndrome (GBS)
• Most common type
• Bilateral weakness
• Paresthesia/dyasthesia
• Begins in the legs and ascends to trunk, arms, cranial nerves
• Respiratory distress in 50% of patients

GBS Incidence
• Most common cause of nontraumatic paralysis in the USA
• Incidence 1 - 2 per 100,000
• Both genders equally affected
• Occurs most often during “Cold and Flu” season
• Peak age groups:
  • Young adults
  • 50-80 years old
GBS Etiology

- Exact cause unknown
- Precipitating Factors
  - Infection — 60-70% of patients report a recent respiratory or GI infection which could be viral (45% *Campylobacter jejuni*, 15% CMV) or bacterial, 10-14 days prior to onset
  - Surgery — 5-10% of patients report recent surgery or epidural analgesia use
  - Vaccination — no sufficient evidence, small percentage of patients report vaccination w/in 8 weeks of symptom onset (antirabies, swine influenza, oral polio)

GBS Mechanism of Injury

- Acute demyelination of peripheral nerves
- Myelin sheath of motor and sensory nerves ingested and destroyed by macrophages
- Recovery possible no destruction of cell body, axon and Schwann cells
  - Cell body and Schwann cells reproduce myelin sheath
  - 85% full recovery

Case Study (con’t)

- On admission to the ED she had a cold sweat, waxing and waning chills and rigors. BP 158/76, oxygen saturation was 95%, HR 81, RR 20, Temp 99.5. The ED MD reported no focal deficits other than generalized weakness throughout all four extremities.
- She has a history of hypertension, no alcohol or substance abuse.
- In the early afternoon she was admitted to med-surg unit with diagnosis of profound weakness, unknown etiology

GBS Symptoms

- Varying degrees of **symmetrical** muscle weakness, tingling, numbness and pain
  - Beginning in legs in stocking distribution, **ascending** to the trunk and arms
    - Within 24 – 72 hrs
    - May lead to respiratory arrest
    - Greatest weakness within 2 weeks of symptoms
    - 90% at their weakest by third week

GBS Diagnostic Tests

- No specific tests
- LP w/ CSF Studies
  - **Increase protein** (>45mg/dL) (Immunoglobulin G)
  - Absence of increased WBCs
  - Normal opening pressure
- Electromyelogram (EMG)
  - Abnormal slowing due to lack of nerve stimulation
- Nerve conduction Velocity (NCV)
  - Slow, < 20% velocity

GBS Course

- Acute Stage
  - Onset of symptoms, rapidly progresses
- Plateau Stage
  - Symptoms remain for few days – few weeks
- Recovery Stage
  - Slowly over weeks to months to 2 years
  - Remyelination and axonal regeneration
  - Varying degrees of muscle weakness, paresthesia, hyperreflexia, distal muscle atrophy, facial paralysis
Case Study (con’t)

• On the med-surg unit her examination showed the following:
  • Denies headache, nausea, SOB, CP
  • Has not voided since admission
  • Weakness of upper and lower extremities
  • Poor grip strength bilaterally
  • BP 156/75, HR 80, RR 20
  • PERL
  • Motor strength all four extremities is 1/5
  • Deep tendon reflexes are diminished
  • Babinski is not present

Case Study (con’t)

• On Day 2 she reports increased weakness in all four extremities, low back pain, nausea and fever
  • She appeared anxious
  • BP 186/114, oxygen saturation 97%
  • Upper extremity strength 0/5
  • Lower extremity strength 0/5
  • Sensation intact
  • Cranial nerves intact
  • Deep tendon reflexes remain diminished

Case Study (con’t)

• She was sent to radiology for a lumbar puncture
• She went into respiratory failure
• Taken to ICU and intubated
• Lumbar puncture resulted in CSF with elevated protein levels

GBS Treatment

➢ Plasmapheresis
  • Removes damaging antibodies
  • 3 - 4 treatments, 1-2 days apart
  • Monitor calcium level, replace
  • May receive second set of treatment

➢ High-dose Immunoglobulin therapy (IVIg)
  • Blocks damaging antibodies
  • 1 - 2 mg/kg in divided doses over 2-5 days

GBS Treatment (con’t)

➢ Corticosteroids – Prednisone
  • Weak evidence, ineffective
  • Increase muscle usage
  • 1mg/kg daily, taper

➢ Immunosuppressive Agents
  • Imuran: monitor bone marrow suppression, elevated liver function

➢ Antibiotics agents
  • Early treatment, erythromycin, campyloacter

GBS Management

• Respiratory Support
  • Months of ventilatory support

• CV Support (autonomic dysfunction)
  • Tachycardia, arrhythmias
  • Impaired hemodynamics
GBS Management (con’t)

• Neurological
  • Irritability
  • Insomnia

• Nutrition
  • Dysphagia - Aspiration (chew & swallow)
  • Enteral or parenteral
  • Daily weights, albumin, prealbumin, total protein

GBS Management (con’t)

➢ Pain Management “generalized aches”
  • Peripheral nerve pain
  • Tylenol, NSAIDS, antidepressants, opioids

➢ Bowel and bladder function
  • Fluids, high fiber diet

➢ Mobility
  • DVT prophylaxis
  • Impaired mobility
  • Positioning, ROM
  • PT, OT, early rehabilitation

GBS Patient’s Experience

• Frightening
• Life altering experience
• Aware of rapid loss of muscle control
• Feel that they are dying
• Experience indignity and helplessness

GBS Patient’s Experience

Case Study - Conclusion

• She spent over a year in the hospital and rehabilitation settings
• Recently returned home
• She is able to stand but is unable to walk
• Uses electric wheelchair to get around

GBS Residual Effects

• 80% Fatigue
• 70% Heavy feeling
• 72% Change in sensation
• 65% Weakness
• 65% Pain in leg/feet
• 32% Mild pain

GBS Residual Effects

GBS Outcome

• 90% recover completely
• 10% permanent disability
• 5% Mortality
• 3% relapse

GBS Outcome
Case Study

Mr. Spine is a 22 year old man who on a dare from his friends attempted a backward flip from a rocky cliff, 20 feet high into shallow water, less than 6 feet. He struck his back on a large protruding rock before entering the water.

SCI Guideline
Prehospital Cervical Spinal Immobilization

• Level II continued
  • Immobilization of trauma patients who are awake, alert, and are not intoxicated; who are without neck pain or tenderness; who do not have an abnormal motor or sensory examination; and who do not have any significant associated injury that might detract from their general evaluation is not recommended.

SCI Guideline
Prehospital Cervical Spinal Immobilization

• Level III
  • A combination of a rigid cervical collar and supportive blocks on a backboard with straps is effective in limiting motion of the cervical spine and is recommended.
  • Immobilization with sandbags and tape is insufficient and is not recommended.
  • Spinal immobilization in patients with penetrating trauma is not recommended because of increased mortality from delayed resuscitation.
SCI Guideline
Transportation

• Level III
  • Expeditious and careful transport of patients is recommended from the site of injury by the most appropriate mode of transportation available to the nearest capable definitive care medical facility.
  • Whenever possible, the transport of patients to specialized acute spinal cord injury treatment centers is recommended.

What’s the Situation in the ED??
1. No motor movement in all extremities
2. No sensation below nipple line
3. Areflexic
4. Priapism
5. BP 89/64
6. Pulse 56
7. Respiratory rate 40 very shallow
8. Poor cough effort
9. Respiratory acidosis (ABG results)
10. Moderate hypoxemia (ABG results)
11. Temperature 96.8
12. Skin warm and dry
13. C/O neck and back pain
14. No gross signs of bleeding
15. Bowel sounds are absent
16. Bladder is distended

SCI Guideline
Clinical Assessment

• Neurological Examination
  • Level II:
    • Neurological assessment tool
    • 2000 American Spinal Injury Association (ASIA) Standards
    • Most consistent, reliable, valid, and responsive scoring system

Spinal Shock

• T6 and above injury
• Complete loss of motor, sensory, and reflex activity below level of injury
• Loss of sympathetic nervous system
• Hypotension, bradycardia, poikilothermia, loss of bowel/bladder, priapism
• Treat with fluid, vasopressors, atropine

SCI Guideline
Acute Cardiopulmonary Management

• Level III:
  • Management in an intensive care unit or similar monitored setting is recommended.
  • Use of cardiac, hemodynamic, and respiratory monitoring devices to detect cardiovascular dysfunction and respiratory insufficiency is recommended.
  • Correction of hypotension (SBP < 90 mmHg) when possible and as soon as possible is recommended.
  • Maintain MAP between 85 - 90 mmHg for the first 7 days is recommended.
Treatment - Hypotension

- SBP below 90mmHg should be avoided or corrected ASAP (SCI Guidelines)
- MAP should be maintained at 85 – 90mmHg for the first 7 days after injury (SCI Guidelines)
- Fluid replacement
- Vasopressor drugs
- Inotropic

Treatment - Bradycardia

- Atropine
- Isurprel
- Consider pacing

Treatment - Thermoregulation

- Poikilothermism
  - Adjustment body temp to room temp
- Maintain normothermia
- Monitor temperature

SCI Guideline
Radiographic Assessment

- Level I - Awake, Symptomatic Patient
  - High-quality CT imaging of the cervical spine is recommended.
  - Routine 3-view cervical spine radiographs are not recommended.
  - If high-quality CT imaging is not available, a 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended - this should be supplemented with CT (when it becomes available)

Radiographic Assessment

*Results of CT Scan
* Hyperextension displacement of C5

SCI Guideline
Initial Closed Reduction of Cervical Spinal Fracture Dislocation

- Level III
  - Early closed reduction with craniocervical traction for the restoration of anatomic alignment of the cervical spine in awake patients is recommended.
  - Closed reduction in patients with an additional rostral injury is not recommended.
  - MRI is recommended if they cannot be examined during closed reduction because of altered mental status
  - MRI is recommended before anterior or posterior surgical procedures
SCI Guideline
Pharmacological Therapy

• Level I
  • Administration of methylprednisolone is not recommended.
  • However, Class I, II, and III evidence exists that high-dose steroids are associated with harmful side effects including death.

• Administration of GM-1 ganglioside (Syngen) is not recommended.

Level of Injury and Respiratory Compromise

• C5–C8
  • Diaphragm intact, but no intercostal muscles
  • Highly vulnerable to problems with secretions, hypoventilation, and atelectasis
  • Decreases in all lung volume measurements
  • Absent or ineffective cough
  • Over time, laboring to breathe leads to fatigue, hypoventilation, respiratory failure, and, ultimately, intubation

Case Study (con’t)

He was then transferred to the ICU. On admission he experienced a decrease in BP that was treated with volume and Dopamine infusion at 5mcg/kg/min. This treatment increased his BP to 110/60.

SCI Guideline
DVT and Thromboembolism

• Prophylaxis - Level I
  • Severe motor deficits
  • Use low molecular weight heparins, rotating beds, or a combination of modalities
  • Low dose heparin in combination with pneumatic compression stockings or electrical stimulation

SCI Guideline
DVT and Thromboembolism

• Prophylaxis - Level II
  • Low dose heparin therapy alone is not recommended
  • Oral anticoagulation alone is not recommended
  • Early administration of VTE prophylaxis (within 72 hours) is recommended
  • Three month duration of prophylactic treatment for DVT and PE is recommended

SCI Guideline
DVT and Thromboembolism

• Prophylaxis - Level III
  • Vena cava filters are not recommended as a routine prophylactic measure, but are recommended for select patients who fail anticoagulation or who are not candidates for anticoagulation and/or mechanical devices.

• Diagnosis - Level III
  • Duplex Doppler ultrasound, impedance plethysmography, venous occlusion plethysmography, venography, and the clinical examination are recommended
SCI Guideline
Nutritional Support

• Level II – Provide indirect calorimetry (metabolic cart) to determine caloric needs

• Level III - Provide nutritional support as soon as possible, within 72 hours

The End

Once stabilized he was transferred to the floor then to a rehab center…It’s another SAVE!!!!