The Pennsylvania Trauma Systems Foundation & Adult Trauma Service

A Brief Overview
Trish Palubinsky, BSN, RN
Trauma PI Coordinator

Welcome To The Trauma Team
Dr. Scott Armen
Trauma Medical Director

Trauma, ICU & Acute Care Surgery Faculty
Trauma Who’s Who

Physician Extenders:
- Tim Baker (PA)
- Lenny Dobson (PA)
- Kelly Perez (PA)
- Dan Watkins (PA)
- Jason Wyse (PA)
- Melissa (Zinn) Steffen (PA)

Trauma Nurse PI Coordinators:
- Sue Lampariello
- Trish Palubinsky

Trauma Who’s Who

- Residents
- Care Coordinators/Social Work
  - Dan Stitt, Chad Lauro, Joey Shannon, Melissa Meshyock, Meredith Stanton
- Registry Staff
- Administrative Support
- Chaplains
- Resp / PT / OT / ST

Trauma Who’s Who

• Nursing

• Team Approach
• Everyone’s role is valuable!
• What do we do?
  Surgical specialists who care for and coordinate the care of injured patients
  Understanding of the special disease process that is trauma & its treatment

• How do we care for trauma?
  Organized approach to the evaluation and treatment of the trauma patient (ATLS)

The Pennsylvania Trauma Systems Foundation Mission

• “In pursuit of optimal support for injured persons in Pennsylvania, the PTSF exists to establish accreditation standards while promoting the advancement of trauma services.”
• “The PTSF is committed to the reduction of death and disability caused by trauma and the provision of expeditious, quality health care that is evidenced based.”

Background

Created by combined efforts:
  • Pa Medical Society
  • Hospital and Health System Association of Pa (HAP)
  • Pa Nurse’s Association
  • Pa Emergency Health Services Council
  • Pa Department of Health
Background

- Commonwealth of Pa first recognized the Foundation when Governor Thornburg signed Act 209 into law – expired in 6/85
- A comprehensive Emergency Medical Services Act – Act 45 was signed into law in 7/85 establishing the PTSF’s mandate.

Purpose of the Foundation

“To develop a private voluntary trauma center accreditation program to:”
- Develop standards of operations – ACS (American College of Surgeons)
- Evaluate any Pa hospital making application
- Conduct site survey visits
- Issue certificates of accreditation
- Establish appeals process
- Develop a statewide trauma registry – PTOS

Structure

20 member Board of Directors:
- 5 members from statewide physician organizations: PMS, PNS, POS, POMA
- 5 members from HAP
- 3 members from PSNA
- 2 members from EMS – PEHSC, PACEP
- Chairman and Minority Chairman of Senate and House Health and Welfare Committees
- Secretary of the Department of Health
Outcome

30 Trauma Centers

- 1 Regional Resource Level 1 Adult & Level 1 Pediatric Trauma Center
- 3 Pediatric Regional Resource Trauma Centers – Pediatric Level I
- 11 Regional Resource Trauma Centers – Level I
- 12 Regional Trauma Centers – Level II
- 2 Regional Resource Centers Level I Adult with Additional Qualifications in Pediatrics – Level II
- 1 Level III Trauma Center

Accredited PA Trauma Centers
November 1, 2012 – September 30, 2013
30 Total Centers

- Abington Memorial Hospital
- Albert Einstein Medical Center
- Allegheny General Hospital
- Altoona Hospital
- Aria Health - Torresdale Campus
- The Children’s Hospital of Philadelphia
- The Children’s Hospital of Pittsburgh
- Geisinger-Community Medical Center
- Conemaugh Memorial Medical Center
- Crozer-Chester Medical Center
- Geisinger Medical Center
- Geisinger Wyoming Valley Medical Center
- Hahnemann University Hospital
- UPMC Hamot
- Lancaster General Hospital
- Lehigh Valley Health Network Cedar Crest
- Paoli Hospital
- Penn State Milton S. Hershey Medical Center
- The Reading Hospital and Medical Center
- Robert Packer Hospital
- St. Christopher’s Hospital for Children
- St. Luke’s University Hospital
- St. Mary Medical Center
- Geisinger-University Hospital
- Thomas Jefferson University Hospital
- UPMC Presbyterian
- UPMC Mercy
- UPMC Presbyterian Hospital North
- UPMC Pinnacle
- UPMC Rankin
- UPMC Shadyside
- UPMC UPMC Presbyterian
- York Hospital

PTSF-PTOS Annual Benchmark 2011 Report

- Mortality rate: HMC: 4.5% State: 5.1%
  (2010: 6.7% State: 5.2%)
- Injury Severity: HMC: 15.1 State: 10.3
- TRISS Suitability: HMC: 98% State: 89%
- Blunt Injury: HMC: 94% State: 92%
- Penetrating: HMC: 6% State: 8%
- Transfer In: HMC: 26% State: 30%
- Direct Scene: HMC: 74% State: 70%
### Benchmark Data - Mortality

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**ACS Filter Review**
- Generated Audits
- Multidisciplinary Rounds
- Pre-Hospital Concerns Sheet
- ED Trauma Concerns Sheet
- Concurrent Case Management/Registry
- Multidisciplinary Trauma M&M
- Department/Division PI
- Individual Concerns

**Trauma Program Manager**
- Trauma Program Medical Director
- POPIMS

**Trauma M&M** (Peer Protected)
- Trauma Core Group (Peer Protected)
- Trauma Oversight Committee (TOC) (Peer Protected)

**CIC**
- Medical Executive Committee
- Quality Management

**Senior Management Team**
(Refer to HMC Organizational Chart)
Current Trauma Performance Improvement Committee

- Timeliness of Care
- Efficacy of Care
- Appropriateness of Care

Complications:
- Injury/Care related Complications
- Co-morbidities

Morbidity

Performance

Patient Outcome
- Survival
- Quality of Life
- Ease of Recovery

SYSTEM

Hospital Oversight Committee

- Trauma M&M

System Enhancements

Trauma Attendings In-house - 24/7/365

- Patient centered, resident & staff oversight – mentorship

Revised triage criteria/tier resources to match patient acuity and care needs

Society of Trauma Nurse's Annual Conference – Savannah GA April 2012
Diligent Triage & Trauma System

- Does it really matter?

“I was hanging pictures with my wife……”

Nail Gun Injury to Heart
Trauma System Impact

Massive Transfusion Protocol

Opportunities Identified in Recent Trauma Performance Improvement Process

- Patient encounter date 8/31/09
- Reviewed care timeline & identified system issues
- Meeting with Blood Bank Leadership 9/2/09
- TMD meeting with several established stakeholders (ED Chair/Blood Bank/Peds Surgery, Anesthesia) for input of proposed changes
- TMD/TPM - Draft new policy with incorporated revisions to be circulated after introduction Blood Bank processes set up

MTP Draft Revisions

- 1st Pack of blood products – administer 4 units thawed plasma
- 2nd Pack of blood products – add 2.0mg rVIIa (NovoSeven)
- After issuing each round of blood products, the blood bank staff with verify that the Trauma Teams wishes to continue the MTP.
### Upgrades

- **Recognition of Shock:**
  - FAST, DPA
- Revision of current MTP
- Appropriate use of AE, including OR AE – revision of Pelvic Fx MG
- Use of pre-peritoneal pelvic packing instead of intraperitoneal packing

### MTP Utilization

- **May – Oct 2009:** Activated 11 times – 5 deaths
- Twice activated for Thawed FFP only reversal of TBI on coumadin

### MTP Utilization Post Revision

- **2/2010 – present:** 40 activations
  - 30 = Trauma patients
  - 13 = Deaths
  - 6 = Unexpected survivors
  - Other services: Transplant=2, GI=4, CT=2, CA=2
Management of Hemodynamically Unstable Pelvic Fractures in Geriatric Patients

Magnitude of the problem

- 139 pelvic fractures
- 44 greater than 65 y.o. (16% died)
- 13 hemodynamically unstable (31% died)

Revised: MG of Unstable Pelvic Fx/Algorithm
Pre-Hospital

- 73/male – Friday afternoon 1300 2/5/10
- "Patient run over by large farm tractor 8,000 lbs– across pelvic area"
- Ground EMS w/helicopter rendezvous
- Initial VSS: 87/56 – 60 – 22 - S02=89, GCS=15, conversing pain “2” on scale
- C- collar, NC O2 bilat IV’s #18
- 17 min flight to pt, & return to HMC w/15 min scene time – Total: 49 mins to definitive care
- Increasing bradycardia/hypotension: 60/33 – 55 enroute

Incident Occurred 56.6 miles from HMC
Estimated 75 min by Ground EMS

Trauma Bay Response

Trauma Bay – Highest Activation Team Response:
- Trauma Surgeon
- Trauma R4
- Anesthesiologist
- EMD Attending
- Ortho R5
- OR Charge Nurse, Chaplain, Respiratory,
- 2 ED Nurses, ED Tech
Trauma Bay Evaluation

- Primary & secondary survey pertinent findings:
  - Patent airway, spontaneous resp. rate 30 w/bilat breath sounds; SAO2=86 w/NRB
  - GCS=15 pupils 4 & brisk -conversing pain scale "10", pulse: 52 – BP: palpated 50 – Temp – 33.4, Skin pale, cool & dry
  - Lower abd tenderness/Pelvis crepitus & instability on palpation – w/BRB & clots
  - urethral meatus, hematomas/swelling bilat groin, rectal - "no tone"
  - Moving all extremities w/pulses present
  - Open puncture lac L lat aspect thigh

AP Pelvis Films

J.T. Injuries ISS = 38
TRISS = 0.390

- Pelvic crush injury
- Open book crush pelvis APC 3 w/blood loss >20% by volume
- Right sacroiliac diastasis
- Pubic symphysis diastasis
- Anterior pelvic disruption
- Anterior pelvic hematoma
- Large amt scrotal hematoma
- Urethral tear
- Dislocation of the right sacroiliac joint and symphysis pubis
- Displaced fractures of the left superior and inferior pubic rami
- Comminuted left sacral fracture
- Displaced fracture of the right posterior eleventh rib
- L thigh degloving injury
- Large right gluteal soft tissue hematoma
Operative Management

- 2/5: To OR for Pre-peritoneal packing, pelvic external fixation and suprapubic catheter
- 2/7: ORIF anterior pelvic ring w/pelvic plating
- 2/16: I&D of pelvic abscess, VAC, closure of abdominal fascia
- 2/19: Abscess drainage, VAC change
- 2/21: Debridement and VAC change
- 2/23: Cystoscopy, repair of bladder, foley, debridement & VAC placement
- 2/26: ORIF posterior pelvis, VAC placement
- 3/3: Removal of ant pelvis internal fixation hardware & ant ext fixator placement, muscle flap
- 3/19: STSG to an pelvis and R leg wound

Summary

- Discharged to rehab at day 56 neuro intact
- ICU days: 32, Vent days: 13, IMC 24
- Occurrences:
  - DVT, Wound Infection, Septicemia, Atrial Fib
- 4/20/2011 – Ortho Office
  Follow up: Home ambulating extensively & square dancing

Accepted for Oral presentation STN
Annual Meeting – San Antonio, TX
TRAUMA.... ends dreams, hopes and families

Injury Death Trimodal Distribution

- > 50% of death occur seconds to minutes after injury
- 30% second peak occurs in the first hours
- 15% third peak occurs days to weeks

Injury Prevention Strategies

- Primary Prevention – prevent the occurrence from happening – Alcohol and minors
- Secondary Prevention – limit the amount of energy transfer- seatbelts, helmets
- Tertiary Prevention – improve the outcome following injury – Trauma Centers and Pre-hospital triage
Injury Prevention Strategies

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Most Effective Strategies??

- Injury prevention strategies implemented at the local "grass-roots level" are the most effective.

Least Effective????

- Educational efforts
Warning……..this is not a test, it is a real life

Traumatic Injury is.....Ugly

• Physical pain & disfigurement
• Creates challenges of recovery – physiological, emotional, spiritual
• Totally changes life functions as you have become accustomed to.....

Hope for the Future

Our children will be belted, helmeted, safe in their own homes/schools, loved and nurtured to enjoy drug free LIVES.
Emergency Medical Services and Spinal Immobilization

Scott Buchle, MHA, CCEMT/P
Program Manager
Life Lion EMS
The early beginnings

- First recorded history was in 1487 when Queen Isabella of Spain had organized the "ambulancias" which were military hospitals. Horse carts brought the soldiers to a resting place.
- Injured soldiers were not picked up until the end of the battle, thus many still died.

Early EMS in America

- First known ambulance in the US was operated by Charity Hospital in New Orleans French Quarter around 1790
- Later followed by Bellevue Hospital in New York in 1809 that carried "modern medical equipment" such as splints, morphine and brandy
- Michael Reese Hospital in Chicago Illinois had the first motorized ambulance in 1899. This was followed in 1900 by New York City. Both were powered by a 2 horsepower electric motor.

American Civil War

Dr. John Letterman modernized Army medicine and organized the US army ambulance corp.
Prior to WWII we see more ambulances being staffed by physicians with units borrowed from funeral homes.

WWII resurgence of ambulance corp. and battlefield medicine.

In the 1960’s we see the development of CPR and defibrillation.

The report “Accidental Death and Disability: The Neglected Disease of Modern Society” also called “The White Paper” became the standard of improving care of the sick and injured.

This single document set the standard for modern EMS. It also put pressure on local and state governments to institute modern EMS in their communities.

- Congress Mandated Changes
- First organized EMT training standards
Generals saw a need to move the sick and injured from the battlefield. War is a great place to experiment with medicine. Much of the modern EMS that we see today we can contribute to the Korean and Vietnam war. The military of today is giving us new technology.

Three experiments were held:
- Los Angeles
- Miami
- Seattle

Doctors thought they could save lives by training firefighters in some skills to "take the ER to the Public." This concept was borrowed from the military.

Days gone by of early medical transportation.
Modern Medical Transportation

OK What about Pennsylvania?
- Exact origins and dates are unknown
- Sprang up from small volunteer organizations, usually Fire Companies
- Pennsylvania Act 45 in 1985 helped build the foundation
- Replaced by Act 37 in 2012. The law we function under today.

Levels of certification
- **Emergency Medical Responder** 48–52 hours of basic EMS training including basic first aid, Oxygen administration and stabilization of cervical spines. Recertification is done every 3 years or can be done with 16 hours of continuing education in 3 years.
Emergency Medical Technicians

- 150–200 Hours of training following the DOT guidelines
- Expanded version of first responder duties including assisted medication administration and ambulance operations
- Required to recertify every 3 years or may obtain 24 hours of continuing education in 3 years

Advanced EMT

- Brand new certification in Pa!!!
- 150–250 hours of training
- 36 con ed credits to recert every 2 years
- Idea is to provide higher than BLS care to rural areas of the Commonwealth
- Protocol driven care
Advanced EMT

- More advanced assessment techniques
- EMTs trained to give SQ, IM and inhaled meds
- Supraglottic airway such as Combi-tube and King Airway
- Basic ECG
- Still working the bugs out of this new certification

Paramedics

- Must be 18 years old
- Follows the National Standard Curriculum as set forth by the DOT and revised in 1998.
- 2000 hours of education plus clinical
- Skills are much more advanced
  - Systems approach to diagnosis
  - Drug and fluid administration
  - Advanced airway skills
  - Advanced trauma management
  - Defibrillation and cardioversion
  - More expansion into Critical Care

Paramedic Cont.

- Work under direct Medical Command
- Permanently certified as long as in good standing with medical command
- Required to have 36 hours of continuing education every 2 years plus must maintain various nationally accepted certification levels in
  - Adult cardiac are (ACLS)
  - Pediatric advanced care (PALS or PEPP)
  - Trauma management (ITLS or PHTLS)
Health Professional
- RNs, PAs and Physicians
- Education through a transition program to familiarize with the prehospital setting
- Follows the same guidelines as Paramedics regarding skills permitted to be performed
- May get orders via Medical Command outside of the basic protocol skills
- Recertification is done the same way as Paramedics and must meet the same requirements

Medical Command Physicians
- Must be board certified to practice medicine in PA
- Must be an MD or DO.
- Must take a nationally approved and credited course to provide medical command
- Must be certified Emergency Physicians

Dr. Meador At “The Box”
What is Medical Command?

- PA Paramedics function under a set group of protocols
- These protocols are planned and written in advance and reviewed yearly by the regional Medical Advisory Committee. Final review and implementation is by the state Medical Advisory Committee
- The protocols follow national standards
- Medics and RN’s may work to a certain point of the protocols. Beyond this point communications must be established with a Medical Command Physician in an ED to proceed

Bottom Line

Physicians are allowing providers to work under their license although totally removed from and having not seen the patient

Pennsylvania EMS chain of Command

**PA Dept of Health**
Dr. Karen Murphy Sec. Of Health
Dr. Doug Kupas State Medical Director

**PA Bureau of EMS**
Richard Givens Director

**Regional EMS councils**
Dr. Michael Reihart Regional Medical Director

**Local Services**
ALS, BLS, First Responder
What's the difference?

- **ALS**  Advanced Life Support  
  - Paramedic units. May be private or hospital based or even municipal

- **BLS**  Basic Life Support  
  - Staffing is usually only EMTs and provides EMT level care.  
  - This is still the majority in the Commonwealth  
  - Usually Private or volunteer services. May also be municipal  
  - Starting to see more for profit services but still rare

- Combination services  
  - ALS and BLS. This is most common in our area

- First Responder  
  - Police and Fire

EMS capabilities

- Basic and Advanced Life Support
- Critical care capabilities (ICU level care)
- All forms of transportation
- MCI and disaster response including pandemic response
- Home health initiatives (beginning)

Pennsylvania Statistics

- **Number of Services**  
  - 572 First Responder Services  
  - 669 BLS services  
  - 376 ALS services  
  - 16 Aeromedical services
- **Number of EMS personnel**  
  - 5,476 First Responders  
  - 38,739 EMTs  
  - 9,759 Paramedics  
  - 1,566 PH RNs  
  - 2,552 Medical Command Physicians
- **Number of calls in 2014**  
  - 1.7 Million
- **911 capability**  
  - 99.9% of the Commonwealth has 911 service  
  - 80.4% of this is 911 enhanced
2 Departments, CCT and EMS making up one division
Part of the Dept. of Emergency Medicine
• 3 Helicopters
  • Paramedic and Nurse staffing
• 15 EMS units (Mobile Intensive Care Units)
  • Paramedic and EMT staffing
• 2 Pediatric Mobile Intensive Care Unit
• 2 Supervisor response units
• 1 Physician Response Unit (EMS Fellowship Program)
• 2 Wheel chair vans

Total staffing combined is 125 people
EMS handles 12,500 calls a year
CCT handles 3,500 calls a year

Prehospital Spinal Immobilization and Transport
Spine And Cord Trauma

• Prevent Further Injury
• Presume Presence Of Injury Until Proven Otherwise

Recognize Spine Injuries

• Pain and Tenderness
• Numbness
• Muscle Weakness Or Paralysis
Always Have a High Index of Suspicion That An Unconscious Patient Has A Spinal Injury

- Maintain Airway
- Maintain Inline Stabilization Until The Patient Is Immobilized On A Long Spine Board
- Secure Entire Patient, Head and Body, To the Long Spine Board
For more info please feel free to contact Life Lion EMS

Questions???
Every event has a defined energy

\[ KE = 0.5 \cdot m \cdot v^2 \]
Speed Kills

Falls

Fall
Burns

2ND DEGREE

- Occurs in the upper region of the dermis
- Blisters appear
- Causes most discomfort
Electrical Burn

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Penetrating Trauma
Bullets produce tissue damage in three ways:
- "Laceration"
- "Cavitations"
- "Shock Waves"
Objectives

- Describe the pathophysiology, clinical manifestations, and medical and nursing management during the acute phase of care for head trauma in adult and pediatric populations
- Describe the pathophysiology, clinical manifestations, and medical and nursing management during the acute phase of care for spinal cord injury in adult and pediatric populations

Overview of Head Trauma

Causes of Brain Injury
Traumatic Brain Injury
- Silent epidemic
  - Death, disability, financial burdens
- TBI defined:
  - An impact, blow, jolt, or penetrating injury that disrupts normal brain function

Key Concepts of Head Trauma
- Primary Injury: point of impact
- Secondary Injury: complications like edema and ischemia
- Clinical exam and CT scanning are the primary ways to differentiate between the various types of head injury

Key Concepts of Head Trauma
- Monroe-Kellie Hypothesis
  - Contents of skull
    - Brain tissue
    - Blood
    - Cerebral-Spinal Fluid
  - When one of the contents increases in size, the others must decrease in order to maintain homeostasis (normal ICP)
- Intracranial Pressure
  - Normal ICP 0-20mmHg
  - Age dependent

Intracranial Pressure

Brain Tissue 60%
Blood 10%
CSF 10%
Other 16%
Key Concepts of Head Trauma

- Volume Pressure Curve

- Cerebral Blood Flow
  - Normal is 750 ml/min
  - Dependent on:
    - Cerebral Perfusion Pressure
      - CPP = MAP - ICP
    - Diameter of cerebral blood vessels
      - Vasodilatation
      - Vasconstriction

$C = \Delta v / \Delta P$

Key Concepts of Head Trauma

What affects the vasculature?

- Oxygen
  - Hypoxemia causes cerebral vasodilatation
  - Cause ICP

- Carbon dioxide
  - Hypercarbia is a more potent stimulus for causing cerebral vasodilatation
  - This will then cause ICP

- Brain receives 20% of resting C.O.

- GOAL: Prevent Secondary Injury

Scalp

- Skin
- Cutaneous tissue
- Adipose tissue
- Ligament layer
- Pericranium

- Blood Vessels located in the subcutaneous tissue are very vascular and do not contract well when injured
Adult Skull Anatomy

- SKULL: 8 bones
- Volume capacity 1500ml
- Sphenoid bone divides interior of the skull into 3 fossae
  - Anterior fossa: frontal lobe
  - Middle fossa: temporal, parietal and occipital lobes
  - Posterior fossa: cerebellum

Infant and Child Skull Anatomy

Thin Skull

- Less protection
- Severe brain injury
- Force transmitted to brain = Less fractures with worse head injury

Infant and Child Skull Anatomy

Anterior and Posterior Fontanelles

Significance:
- Anterior fontanelle
- Posterior fontanelle
- Tense, bulging or sunken

Intervention:
- Assess fontanelle at development
Infant and Child Skull Anatomy

Cranial Sutures

Significance:
- 16-18 mo
- Increase in volume
- Better accommodation
- Increased intracranial pressure still exists

Intervention:
- Measure and follow head circumferences in children less than 2 years.

Infant and Child Skull Anatomy

Top Heavy

Significance:
Infant head is 20% of BSA.

Intervention:
- Anticipate head injury.
- In sudden deceleration injury, head is first to strike the object.
  **A 30mph unrestrained crash has same forces and intensity as a fall from a 3 story building.**
Brain Injury Classifications
- Blunt vs. Penetrating
- Closed vs. Open
- Focal (contusion or hemorrhage) vs. Diffuse
  - Focal lesions: dysfunction specific to the injured area of the brain
  - Diffuse injuries: global dysfunction, i.e. loss of consciousness, cognitive and memory problems
- Hemorrhagic vs. Non-hemorrhagic

Pathophysiology of TBI

<table>
<thead>
<tr>
<th>Primary tissue injury</th>
<th>Secondary injury RN KEY!</th>
</tr>
</thead>
<tbody>
<tr>
<td>The initial insult or injury</td>
<td>Injury that occurs as a result of the primary injury</td>
</tr>
<tr>
<td>Tissue injury due to trauma mechanism</td>
<td>Tissue damage builds over minutes-hours after primary injury</td>
</tr>
<tr>
<td>contusion, tissue shearing</td>
<td>Ischemia from elevated ICP and/or systemic hypotension</td>
</tr>
<tr>
<td>Focal - localized to one area of the brain</td>
<td>Metabolic toxins:</td>
</tr>
<tr>
<td>Diffuse - global injury to the brain</td>
<td>i.e. Release of excitotoxic transmitters, oxygen free radicals, calcium derangement</td>
</tr>
</tbody>
</table>

Clinical Assessment: Look for Changes
- !!!LOC!!!!
- Motor function
- Pupillary signs
- Vitals
- History
Clinical Grading is done using GCS (Adult)

- Mild - GCS 13-15
  Patient typically mildly lethargic, disoriented

- Moderate - GCS 9-12
  Patient typically sleepy or obtunded, able to follow commands with arousal. Confused.

- Severe - GCS 3-8
  Patient comatose, unable to follow commands or perform purposeful motor activity.
  Range of motor activity: flaccid, withdrawn, decorticate posturing, decerebrate posturing, nil.

Modified Glasgow Coma Scale*

- **Eye Opening**
  - Spontaneously (4)
  - To voice (3)
  - To pain (2)
  - No response (1)

- **Verbal Response**
  - Coos and babbles or age appropriate (5)
  - Irritable cry (4)
  - Inappropriate words or sounds (3)
  - Incomprehensible sounds to stimuli (2)
  - No response (1)

- **Motor Response**
  - Moves spontaneously and purposefully (6)
  - Withdraws to touch (5)
  - Withdraws to pain (4)
  - Decorticate posturing (3)
  - Decerebrate posturing (2)
  - No response (1)

*Modifications in Bold

Table 12.5 - Modified Glasgow Coma Scale

<table>
<thead>
<tr>
<th>Child/Adult</th>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes</td>
<td>Open eyes spontaneously</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Withdraws to pain</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>No response</td>
<td>2</td>
</tr>
<tr>
<td>Motor</td>
<td>Open eyes spontaneously</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Withdraws to pain</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>No response</td>
<td>4</td>
</tr>
<tr>
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<td>Withdraws to voice</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Irritable cry</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Incomprehensible sounds to stimuli</td>
<td>1</td>
</tr>
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</tr>
<tr>
<td></td>
<td>No response</td>
<td>2</td>
</tr>
<tr>
<td>Total score</td>
<td>3-15</td>
<td></td>
</tr>
</tbody>
</table>

Treatment of TBI

- Prevention
- First Responders
- ER Resuscitation
- Definitive Diagnostic Studies
- Definitive Treatment
- Prevent hypotension, hypoxia, and maintain CPP

Management of TBI: Prehospital

- ABCs
- Fluid resuscitation to reverse shock, hypotension
- Spine precautions
  - 5-10% of head trauma patients have unstable spine injury
- Effective EMS and air ambulance systems dramatically reduce mortality from head trauma

Initial Evaluation and Resuscitation: ED

- Rapid neurological examination (1-3 minutes)
  - Assess GCS, pupil function, doll’s eyes, cough, gag, corneal reflex
- Management of elevated ICP
  - Intubate, ventilation, sedation, mannitol, head elevation, access
- Secondary injury survey
  - Examine head, ears, eyes, nasopharynx, mouth for injury, facial fractures, C-spine x-rays,
  - Evaluate for peripheral injury
- STAT head CT scan
  - Diagnostic procedure of choice for all patients with suspected traumatic brain injury
- Repeat neurologic exam frequently

TIME IS BRAIN!!
ED Management cont’d
- Blood samples-including Toxicology
- Expedient radiologic exam/CT scans
- Fluid resuscitation
- Correction of abg blood values-PaCO₂ 35-40
- Treat hypoxia and hypotension
- Crime scene preservation???

TBI Treatment: Ongoing
- Optimize Cerebral Perfusion (CPP=MAP-ICP)
  - Treat systemic shock, hypoxia
  - Reduce intracranial pressure with surgical and medical means
- Maintain CPP>60, ICP<20 with osmotic diuretics like mannitol, hypertonic fluids, sedation, and CSF drainage
- Immediate surgery for evacuation of hematoma causing mass effect
- ICP monitoring for any unconscious patient or patient at risk for expanding hematoma GCS 8 = ICP monitoring
  - Serial head CT scans - benefits vs. risks

Surgical Management
- If CT shows surgical lesion, patient is taken to OR for definitive treatment
- May be simultaneous with surgical repair of other injuries
- Decompressive frontal or temporal lobectomy is not routinely done, bone flaps can be removed
- Placement of ventriculostomy (EVD) is usually done in OR (but can be done at bedside)
Nonoperative Management
- No surgical lesion
- Specialty consultants in ED or ICU

Fluid Management
- 0.9% saline
- May add dextrose for maintenance depending on situation (pediatrics, not adults)
- Minimum of q6 hr. Na checks
- Initial Na and Gluc goals=Normal for age

Management of Intracranial Pressure (ICP)
- Ultimate decision on whether to monitor and what type of monitor is by the Attending Neurosurgeon
- Monitor until 48 hrs of ICP < 20 mmHg or sustained improvement of neuro exam
ICP Management cont’d
- Minimize time ICP is >20
- Do not cluster care
- Maintain CPP > age guideline level
- Tiered Approach-advance tiers if unable to control ICP
- Decisions regarding ICP control are made cooperatively between Neurosurgery and PCCM services
- Neurosurgery is notified immediately of deterioration requiring advancement of level of care

What can I do as the patient’s nurse to decrease ICP?
- HOB Up (Do not bend unless spine is cleared)
- Head Midline to encourage venous drainage from brain
- Low stimulation environment
- Help to decrease metabolic rate, NO fevers
- Limit visitors; limit stimulation at the bedside

ICP Therapy-
Prevent Secondary Brain Injury
- Adequate sedation
  - Avoid propofol in children <18 in accordance with FDA guidelines
  - PCO2 35-40; Avoid acidosis (hyperventilation last ditch effort)
- Manage CPP (MAP-ICP= CPP)
  - Mannitol or 3% Saline, NEW 23.4% HTS
  - Normothermia (36.5-37.5)
  - Normotension (for age)
  - Consult Neurosurgery
ICP Therapy- Anticonvulsants

Prophylactic Anticonvulsant Therapy

“Especially with temporal lobe injuries”

- Discretion of attending NS
- Prevention of occurrence of early post-traumatic SZ in high-risk children during 1st week after injury
- Greater than 7 days is not recommended

Severe Head Injury Guidelines

- Severe Head Injury Classified:
  - Post-resuscitation GCS ≤ 8
  - Previously Intubated, Best Motor Response ≤ 3

Scalp Lacerations

- Treat 'em and street 'em
- Microsutures for face
- Staples or sutures for scalp inside hairline
- Remove facial sutures in 7 days and scalp sutures/staples in 10 days
Concussion

- Brief loss of consciousness with normal head CT scan, normal neuro exam
- Patient may have mild lethargy and/or confusion
- Treatment: observation
- In sports, avoid any risk of re-injury
  - Contact sports excluded until any symptoms have completely resolved.
- Second impact before full recovery may be fatal

Concussion

- Difficult to Diagnose
- Patient history
- One of most common injuries after trauma
  - MVC, Falls, sports etc.
- Can lead to life-long complications
- Proper management important

The AAN guidelines: Concussion Grades

- The AAN defines concussion as a "alteration of mental status due to biomechanical forces affecting the brain". The AAN definition does not require a loss of consciousness.
  - Grade 1:
    - Transient confusion;
    - No loss of consciousness;
    - Concussion symptoms clear in less than 15 minutes.
  - Grade 2:
    - Transient confusion;
    - No loss of consciousness;
    - Concussion symptoms or mental status abnormalities last longer than 15 minutes.
  - Grade 3:
    - Any loss of consciousness, either brief (seconds) or prolonged (minutes).
- The AAN guidelines make it clear that permanent brain injury can occur with either Grade 2 or Grade 3 concussion. Thus, it is clear that subtle brain injury can have permanent consequences if the acute symptoms of the concussion continue for more than 15 minutes.
Concussion Symptoms

- **Cognitive**
  - Attention difficulties, concentration problems, memory problems, orientation problems

- **Physical**
  - Headaches, dizziness, insomnia, fatigue, uneven gait, nausea, blurred vision, seizures

- **Behavioral**
  - Irritability, depression, anxiety, sleep disturbances, emotional control, loss of initiative, problems R/T social situations

Penn State Concussion Program

- Dr. Harry Bramley and team
- Diagnosis
- Testing
- History assessment
- ImPACT testing
- HMC docs work with NFL

Post-Concussion Syndrome

Due to shearing of axons:
- Chronic headaches
- Fatigue
- Apathy
- Inability to function in normal situations
Skull Fracture

• May or may not have associated underlying brain injury

• Any associated dural tear or brain laceration requires surgical repair

Linear Skull Fractures: observe

Depressed Skull Fracture – Compound

• Can be complex
• If scalp is open, dura may be open
• Surgical intervention
• Irrigate and close in the O.R.
• Antibiotics
Depressed Skull Fracture - Complex

Basilar Skull Fractures

- Basilar skull fracture – fracture around orbital roof, sphenoid bone, or petrous or mastoid portion of temporal bone.
- Battle’s or Raccoon’s eye signs
  - May be associated with injury to cranial nerves 2, 7 or 8, or CSF leak into nose (rhinorrhea) or ear (otorrhea); these require special attention
- Do not put anything up the nose!!

Cerebral Contusion / Intracerebral Hematoma

- Area of focal tissue injury.
- Neurological deficit depends on area injured.
- Commonly occur in coup/contrecoup pattern
  - i.e. frontal / occipital
  - 20% of contusions may expand into surgical hematoma
  - Observe patients in ICU, repeat head CT scan within 24 hours.
Contusions

Hematomas

Epidural Hematoma:

- Lens shaped hematoma between dura and skull (arterial bleeding)
- Associated with skull fracture and laceration of dural artery (i.e., middle meningeal artery).
- Underlying brain is usually not injured
- Brief loss consciousness, followed by lucid interval of minutes to hours, before rapid neurological decline into coma (test!)
Subdural hematoma - SDH

- Crescent shaped; between brain and dura, conforms to surface.
- High acceleration/deceleration injury
- Usually severe diffuse injury, immediate coma from moment of impact
- Extreme neurosurgical emergency, can be worse than EDH

Subdural: Pediatrics

- Subdural Bleeds: More common in children than epidural bleeds
- Nonspecific presentation of subdural hematoma
  - Lethargy, drowsiness, irritability, retinal hemorrhages, seizures, bulging fontelles
- Treatment: evacuation of large hematomas, both subdural and epidural

Chronic subdural hematoma

- Usually in older patients
- Minor trauma causes small, often minimally symptomatic subdural hemorrhage
- As clot liquefies, the hemorrhage may expand into a significant mass.
- CT appearance, hypodense crescent shaped mass between dura and brain.
- Present: elevated ICP and hemiparesis.
- May also cause TIA-like episodes or seizures. Family sees change in LOC
- Surgical drainage of hematoma via burr holes
DAI - Diffuse Axonal Injury
- Shear injury or brain stem contusion
- High acceleration/deceleration injury with shock waves and momentary tissue distortion causing microscopic tearing of nerve fibers.
- Radiographically consists of small petechial hemorrhages in white matter tracts.

DAI - Diffuse Axonal Injury
- Manifested by deep coma
  - After 6 months, 94% remain in PVS or die
- Often associated with severe cerebral edema and ICP elevation.
- Mortality is 30–40%, good outcome 20–30%.
- No specific treatment – treat all secondary injuries
  - “Shaken Baby Syndrome”

Intracranial Hemorrhage
Subarachnoid Hemorrhage

- Aneurysmal rupture vs. traumatic rupture of vessels
- Treatment is ventriculostomy
- Major intraventricular bleeds carry poor prognosis

Cerebral Swelling/Edema

- Increased brain water content, either intracellular or extracellular.
- The brain is susceptible to injury from edema – skull is a confined space and cannot expand (adults).
- The brain has no lymphatic pathways within the CNS to carry away the fluid accumulates.

Hypoxia: Anoxic Brain Injury

- An injury that results from a lack of oxygen to the brain.
- This is most often from a lack of blood flow due to injury or bleeding.
- S/P Code?
Herniation Syndromes

- 1 – Subfalcine
  - Across the falx
- 2 – Uncal (tentorial)
  - Laterally across the tentorium
- 3 – Tonsillar (most common)
  - Through the Foramen Magnum
- 4 – Transcalvarial
  - Path of least resistance

Herniation

- EMERGENCY!!!!
- Looking for change in LOC, most sensitive indicator
- Pupil changes, Cushing’s Triad
- Cranial Nerve change (loss of cough, gag, corneal)

Penetrating Head Injuries

- DO NOT remove the object!!
- Stabilize object
- Stop the bleeding
- Consider prophylactic antibiotics and antiepileptics
Gunshot wound - GSW

- Causes mixtures of skull fracture, DAI, intracerebral hemorrhage, epidural and subdural hematomas, in addition to direct tissue injury.
- May also cause injury to major cerebral vessels.
- High velocity weapons cause extreme diffuse injury from tissue cavitations.

A word about prevention:

- Teach injury prevention
- Use clinical judgment
- Use resources

Preventing Secondary Brain Injury

- Control ICP and CPP
  - Cerebral Perfusion critical
  - Prevent cerebral ischemia
- Monitor Labs
  - ABG's and electrolytes, serum osmolality
- PREVENT: VAP, CLABSI, CAUTI, early rehab
  - Prevent infection
  - Prevent secondary injuries
Nervous System: Function

- Controls motor, sensory, autonomic, cognitive and behavioral functions of the body
- 3 major functional units
  - Spinal cord level
    - Lowest level
  - Brain stem and subcortical
    - Second level
  - Cortical level
    - Highest level

Nervous System: Divisions

Central Nervous System
- CNS
  - Brain and Spinal Cord

Peripheral Nervous System
- PNS
  - 12 cranial nerves
  - 31 spinal nerves
**Autonomic Nervous System**

**Parasympathetic**
- "conservation and normal function"
- Decreases HR
- Increases gastrointestinal activity
- Pupillary Constriction

**Sympathetic**
- "fight or flight"
- Activated during stress situations
- Increases HR and BP
- Vasoconstriction of peripheral blood vessels
- Pupillary Dilation

**Spinal Cord**

**Grey Matter**
- Neuronal cell bodies and synapses

**White Matter**
- Ascending Pathways
  - Relay sensory information to the brain
- Descending Pathways
  - Relay motor instructions down from the brain
Spinal Pathways

- **EFFERENT**
  - Motor fibers
  - Anterior Horn
  - Descending
  - Action

- **AFFERENT**
  - Sensory
  - Posterior Horn
  - Ascending: impulses to the brain
  - Feeling

Motor Neurons

**Upper Motor Neurons**
- Cerebral cortex and brainstem
- Spastic Paralysis
- Increased muscle tone
- No significant muscle atrophy
- Fasciculation and fibrillation not present
- Hyperreflexia
- ? Babinski reflex

**Lower Motor Neurons**
- Spinal cord
- Flaccid Paralysis
- Significant muscle atrophy
- Fasciculation and fibrillations present
- Hyporeflexia
- No Babinski reflex
Vertebral Column

33 Vertebrae
- 7 Cervical
- 12 Thoracic
- 5 Lumbar
- 5 Sacral (fused as one)
- 4 Coccygeal (fused as one)
- 24 Intervertebral Disks

Basic Anatomy

Spinal Nerves
- C1-C7 exit above corresponding vertebrae
- T1 and below exit with corresponding vertebrae

- **Dorsal Roots**
  - (Sensory/afferent)
  - Dermatomes
    - Interruption results in paresthesia or pain in a dermatomal area

- **Ventral Roots**
  - (Motor/efferent)
  - Spinal cord to body
  - Myotomes
Dermatomes and Myotomes

C3,4,5—keep the diaphragm alive

Spinal Cord Injury

Over half of SCI are cervical level

- Sustain SCI as Result of
  - Vehicular accident
  - Assaults/Abuse
  - Falls
  - Sports related injuries
Influences on Spinal Cord Injury

- Small canal size
- Limited vascular supply
- Osteophytes from cervical spondylosis
- Age (osteoarthritic changes)
- Bruised or compressed SC (not severed)
- Congenital anomalies have narrow canal

Growth and Development

- Large head mass increases momentum
- Lack of neck muscle strength
- Vertebral bodies are angular not square
- Subluxation at C2-3 in adults C5-6 with angle of fulcrum

What about kids and SCI??

- Children have a wider cervical canal
- Fewer children with traumatic cervical injuries become quadriplegic
Mechanism of Injury

- Acceleration (hyperextension)
  - Foot on the gas pedal
  - Whiplash stress
  - Falls

- Deceleration (flexion)
  - Foot on the brake

Mechanism of Injury

- Compression
  - Vertical force exerted on spinal column
  - Landing on feet when falling, jumping from a height, object falling on head

- Penetrating
  - Missiles
  - Penetration of spinal column

Prehospital Care: IMMOBILIZE

- Maintain neutral position
- Avoid flexion and extension
- Prevent aspiration
- Airway and spine management
Physical Assessment

- History
  - Mechanism of action
  - Recall of events after accident??
  - Treatment received at scene
  - Mode of transport
  - Symptoms at time of injury
  - Emergency Team will perform ASIA impairment scale

The ASIA Impairment Scale:
Assesses Motor and Sensory

A: Complete: No motor function or sensation is preserved in sacral segments S4-S5.
B: Sensory incomplete: Sensation but no motor function remains below the level of injury and includes the S4-S5 sacral segment of the spinal cord.
C: Motor incomplete: Motor function remains in more than half of key muscles below the level of injury, with muscle strength grade of 3 or greater. Sensory function is present below the neurological level and includes sacral segments S4-S5.
D: Motor incomplete: Motor function remains below the level of injury and at least half of key muscles below the level of injury, with muscle strength grade of 3 or greater. Sensory function is present below the neurological level and includes sacral segments S4-S5.
E: Normal: Motor and sensory function is normal.

**Sensory is done on both R and L, then Motor on both R and L, the single neurological level where both motor and sensory are NORMAL is your level of injury**
Specific Findings and Injuries

Physical Assessment
- ABC's
- Vital Signs
- Radiographic evidence
  - X-rays
  - CT
  - MRI

CLINICAL AND RADIOGRAPHIC

Clinical Criteria to R/O C-Spine Fractures
- Does not complain of neck pain
- Does not have neck tenderness
- No history of LOC
- No change in mental status
- No paralysis or sensory changes
- Able to cooperate with an exam
  - Above criteria and cleared radiographically
Studies to Clear the C-Spine

- Lateral that includes C1-7 and T1
- Anterior – posterior view
- Open mouth odontoid
- Supine oblique (swimmers)
- CT Scan
- MRI

Indications for Radiographic Evidence

- X-rays
  - Neck pain/tenderness
  - Decreased pain perception
    - CHI
    - ETOH/drugs
    - Mentally disabled
    - Penetrating trauma
    - Neuro symptoms

- CT scan
  - Inability to see C1-7 on plain films
  - Vertebral body burst fractures
  - Suspected posterior column fractures
  - Marked DJD
  - Patient weight >350 lbs.

- MRI
  - Odontoid fractures
  - Poor quality CT
  - Facet fractures
**ABCD’S of C-spine Clearance**

A = Alignment and Anatomy  
B = Bony Integrity  
C = Cartilage or Joint spaces  
D = Disk Spaces  
S = Soft Tissue 

---

**Cervical Spine Views**

**Lateral**

**A-P**

**Open Mouth**

---

**Thoracic, Lumbar, & Sacral Spine Clearance**

- Thoracic spine fractures occur 2 to 5%  
- 20% of cases without pain or tenderness  
- A-P and lateral views  
- TLS precautions  
- Log roll until cleared
Lap Belt Complex: Combo Injury

- Flexion at lumbar spine with fracture
- Abdominal organ injury
- Seatbelt bruising
- Intestinal perforation

SCIWORA Injuries (test)

Spinal Cord Injuries Without Radiographic Abnormalities

- Not as common now that testing has improved
- No radiographic abnormalities
- Elastic ligaments stretch as well as the cord
- Neuronal to complete severing 70% of pediatric cord injuries
- Most common in kids under 8
- Can have delayed onset up to 5 days

Clearing the Spine

Who ??
- Emergency Department physician
- Trauma Attending with radiologist
- Spine service (Ortho vs. Neuro)

How ??
- Films and clinical exam
Soft Tissue Injuries (no bone issue)
- Cervical signs
  - Nuchal rigidity
  - Neck/shoulder pain
  - Limited movement, muscle spasms
  - Headache, dizziness, vertigo
  - Tinnitus
  - Paresthesias
  - Bicep weakness

Soft Tissue Injuries cont’d
- Lumbar signs
  - Pain, numbness, or weakness in the buttocks, thigh, or calf to heel
  - Inability to walk on toes
  - Hamstring weakness
  - Absent ankle jerk reflex
  - Foot drop

Vertebral Injuries
- Simple fractures
- Compression fractures
- Comminuted fractures
- Tear drop fractures
- Special cervical fractures
- Dislocation
- Subluxation
Simple Fractures

Compression Fractures
- Extreme force to cervical spine
- Vertical compression
- Seen in a slip or fall

Types of Cervical Fractures
- Comminuted
  - Burst fracture
- Tear Drop
  - Hyperflexion injury...i.e. diving accident
  - Most severe
- Jefferson
  - Burst fracture of the ring of C1
- Hangman’s
  - C2 fracture; upper cervical pain after MVA
Normal Odontoid

Odontoid Fractures
- **Type I**: occurs through the upper part of the odontoid process: Rare, unstable
- **Type II**: occur at the junction of the odontoid process with the vertebral body: Most common
- **Type III**: extends down into the body of the atlas: Usually stable

Odontoid Fractures
- Type I and III do not require surgical treatment: High Posterior Cervical Pain
- In undisplaced type II fractures in patients under age 40, halo immobilization is usually recommended and is successful in over 60% of cases
- Significant displacement or angulation of the fracture, particularly in older patients, surgery may be recommended.
Dislocation and Subluxation

- Usually results from an MVA in which an unrestrained occupant's head strikes the windshield or dashboard
- Hyperflexion of the neck
- Symptoms will be present when the atlas moves far enough forward on the atlas to narrow the spinal canal and impinge on the spinal cord

Treatment
- Surgical fusion of C1 and C2

Specific Cord Injuries
Cord Injuries: Complete or Incomplete?

- Concussion
  - motor sensory deficit
  - Short period of time
- Compression/stretching-cord ischemia
- Contusion- bruising of the cord- blood present
- Laceration
- Hemorrhage
- Transection- may be due to knife vs. injury
- Vascular damage/ ischemia
  - Hematomyelia- bleeding into the cord

Spinal Cord Injuries

**Cervical Signs >C5-6**

- Flaccid areflexia
- Diaphragmatic breathing
- Pain above clavicle
- Priapism
- Neurogenic shock
- Anticipate intubation

**Lumbar signs**

- Flaccid/spastic areflexia
- Pain above injury
- Below T6 less likely to see shock
Cord Concussion
- Sudden transient loss of function of the spinal cord due to trauma.
- Due to severe shaking
- Temporary loss of function for 24-48 hours

Cord Transection

Complete SCI
- Total sensory and motor loss below level of injury
- Autonomic losses
  - Loss of vasomotor control
  - Loss of bowel and bladder
  - Temperature issues
Incomplete Cord Injury Syndromes

1. Central Cord
2. Anterior Cord
3. Brown Sequard: test question
4. Posterior Cord

Incomplete means some level of function below the injury

Central Cord Syndrome

- Hyperextension injury; most common esp. in elderly with degenerative changes that narrow the spinal cord
- Cause: bleeding into the central portion of SC
- Impairments: Move Legs but not Arms
- ? Bowel/bladder return

Anterior Cord Syndrome

- Flexion injury. Worst prognosis of incomplete injuries. Rare
- Cause: rupture of posterior ligaments -> forward dislocation and stretch of cord or occlusion of anterior spinal artery
- Impairments: loss of motor, pain, temperature bilaterally
- Position, vibration, touch spared Dissociated sensory loss below the injury
- No bowel/bladder return
Brown Sequard Syndrome

- **Spinal Cord Hemisection**: best prognosis of incompletes
- **Cause**: ½ of SC damaged
- **Impairments**:
  - Motor + position loss on side of injury
  - Temperature + pain loss on opposite side of injury
- Y Bowel/bladder return

Posterior Cord Syndrome

- **Most Rare**
- **Cause**: compression by a tumor or infarction of posterior spinal artery
- **Impairments**: loss of position, vibration, + touch below the lesion,
  - Pain and paresthesia in neck, upper arms, torso

Treatment for Cord Injuries

- Maintain spinal stabilization
- Spine service consult
- Circulatory Support
- Surgical decompression
- Pain Management
- Nutrition
A few words about steroids...

- Glucocorticoid therapy can cause unwanted side effects
  - Delayed wound healing
  - Systemic immune suppression
  - GI bleed
- Use of solumedrol in adults/pediatrics is injury and attending specific

No longer mainstream treatment

Acute care management

**Peds:** Solumedrol may be used if paralysis present:
- Initial infusion:
  - 30 mg/kg in 50 cc over 30 minutes
- Continuous infusion:
  - 5.4 mg/kg in 500 cc for 23 hours

**Adults:**
- Methylprednisolone protocol
  - 300 mg/kg IV bolus over 45 mins.
  - Wait 15 mins.
  - 5.4 mg/kg/hr over 23 hours

Complications to prevent...

- Shock states
- Skin breakdown
- Immobility
- Respiratory compromise
- Infections
Neurogenic Shock (****)
- Seen with injuries at T6 and above
- NOT a circulatory phenomenon- Sympathetic outflow is disrupted resulting in unopposed vagal tone i.e.: loss of vasomotor tone caused by injury
- Can have full recovery- often mimics hypovolemic shock without increased HR d/t vasodilatation, venous pooling and decreased CO
- Features: hypotension, bradycardia, warm and dry

Autonomic Hyperreflexia (AH)
- At or above T6, occurs in up to 85% of patients with complete SCI above T6
- Sympathetic + Parasympathetic Reaction to stimulus
- Lower motor neurons sense painful stimuli and transmit the stimuli up to the SC
- At the level of injury the stimulus is interrupted and the signal can not reach the cerebral cortex
- Major sympathetic nervous system changes occur above level of injury
- Brain attempts to compensate by slowing the heart rate and vasoconstricting

Neurogenic vs. Autonomic
- At or above T6
- Vasodilatation d/t sympathetic outflow disruption
- TX: support with gtt's and fluid
  - T-lying if able
  - Don't over fluid resuscitate
- Features
  - Hypotension
  - Bradycardia
  - Usually warm dry skin
- At or above T6
- Sympathetic + Parasympathetic Reactions to stimulus
- TX: Remove Stimulus: BLADDER, bowel, skin, reproductive, none
- Features
  - Hypertension
  - Bradycardia
  - Metallic taste
  - Pounding headache
  - Flushed
  - Diaphoretic
  - Cool and pale below injury

“Spinal shock”: temporary neurologic syndrome -loss of spinal reflex activity occurring below a total or near total spinal cord injury
PREVENTION is KEY!!

- Seatbelts on every ride
- Car seats used correctly to age 8
- No diving in shallow water
- No use of baby walkers
- Helmets if on wheels

Questions?

Question Fun!
- Hyperventilation in severe TBI patients causes:
  - A. Increase in delivery of O₂ to damaged brain tissue
  - B. Manages metabolic acidosis thus assisting with O₂ delivery
  - C. Cerebral vasodilation and increase cerebral perfusion
  - D. Cerebral vasoconstriction and reduced cerebral perfusion
D. Cerebral vasoconstriction and reduced cerebral perfusion

The cardiovascular consequences of neurogenic shock include:
A. HTN, Tachycardia, hyperthermia
B. Low BP, Bradycardia, hypothermia
C. Low BP, Tachycardia, hyperthermia
D. HTN, bradycardia, hyperthermia

B. Hypotension, bradycardia, hypothermia
References

- Pictures are from
  - Microsoft Clip Online
  - Google images
  - Permission for other images obtained

Websites:
- www.cdc.gov
- www.aap.org
- www.safekids.org
- www.AANN.org

Books:
At the conclusion of this presentation the participant will be able to:

- Identify the key anatomical structures of the face and eye and the impact of force on those structures
- Discuss assessment priorities for a patient with maxillofacial and ocular injuries
- Prioritize the care of a patient with facial and ocular injuries
- Discuss psychosocial support for a patient with maxillofacial and ocular injuries

**Mechanism of Injury**

- Low velocity
- High velocity
WARNING!!

GRAPHIC PHOTOS....

The Basics

- Bones of face make up the most complex skeletal area of the body
- Maxillofacial fractures result from either blunt or penetrating trauma
60% of patients with severe facial trauma have multisystem trauma and the potential for airway compromise.

Important info....

Airway Management

- Protect and maintain airway
  - Pull tongue forward with padded forceps or sutures
  - Endotracheal intubation
  - Anticipate need for cricothyroidotomy
- Prevent aspiration
- Ensure adequate oxygenation and ventilation

Airway Management

- Protection of airway
- Keep HOB elevated
- Aggressive pulmonary toilet
- Frequent suctioning
Maxillofacial Injuries General Assessment

- ABC’s
- Assess for symmetry of facial structures
  - Assess for paresthesias
  - Assess symmetry of facial movements
- Assess the ears, nose and oral cavity for occult lacerations, hematomas
- Palpate for crepitus, tenderness or deformity
- Assess sense of smell

Physical Exam - GENERAL

- Visual acuity
- Pupil assessment
- Eye position and movement
- Extraocular muscles
- Lid lacerations
- Palpate around the entire orbits

- Inspect open wounds for foreign bodies
- Palpate the entire face for crepitus, deformity and subcutaneous air
- Inspect the nose for asymmetry, widening of the nasal bridge
- Inspect nasal septum for septal hematoma, CSF or blood
EYE INJURIES
Eweewww...
Physical Exam - EYE
- Intraocular pressure
- Examine the cornea for abrasions and lacerations
- Examine the anterior chamber for blood or hyphema
- Perform fundoscopic exam and examine the posterior chamber and the retina

Direct Eye Trauma

Blast Injury: Thermal Injury
**Thermal Injury**

- Eye is usually spared
- Corneal exposure may occur as burn heals and skin contracts

**Corneal Abrasion**

**Chemical Burns**
**Traumatic Hyphema**
- Limit activity
- Keep HOB elevated
- Protect the eye
- Cycloplegic agents
- Monitor for re-bleeding
- Avoid NSAIDS and anticoagulants
- Amicar

**Lid Lacerations**

**Ruptured Globe**
- Globe laceration
- Tetanus
- Antibiotics
- REFER
  - 24 hours
  - no altitude restrictions
**Ruptured Globe**

- Minimize additional damage
  - Make sure a shield is used
  - Do not use a patch which applies pressure
  - Avoid bearing down
  - Be prepared for patient to go to the OR
  - NPO

**General Eye Injury Management**

- Protect eyes from further injury
- Pain management
- Early Rehab Consult

**FACIAL FRACTURES**

- Orbit, Maxilla, Zygoma, Mandible
6_Maxillofacial and Ocular Injuries

Bony Orbit

- Roof
  - Frontal bone
  - Sphenoid
- Medial wall
  - Maxilla
  - Lacrimal, ethmoid
  - Body of sphenoid
- Floor
  - Maxilla
  - Palatine
  - Zygoma
- Lateral
  - Zygoma and greater sphenoid

Orbital Fractures

- Enophthalmos
- Restricted eye movements
- Diplopia
- Ecchymosis
- Subcutaneous emphysema

Symptoms

- Periorbital swelling
- Crepitus
- Proptosis
- Ophthalmoplegia
- Enophthalmos
- Palpable defects
- Assess for globe injury
- Avoid nose blowing
- Assess for entrapment
Nasal–Orbital–Ethmoidal Fractures

- Fractures that extend into the nose through the ethmoid bones
- Associated with lacrimal disruption and dural tears
- Suspect if there is trauma to the nose or medial orbit
- Patients often complain of pain on eye movement
Periorbital hematoma
Raccoon eyes suggestive of basal skull fracture.
No NG tube!
Nursing Management

- Prevention of infection
  - Perioperative antibiotics
  - Frequent oral lavage
  - Minimize nasal packing and tubes
  - Decongestants
  - Avoid blowing nose
  - Avoid foreign bodies or instrumentation in nares or ear canal

Mandible Fractures

Physical Exam - MANDIBLE

- Check facial stability
- Inspect the teeth
- Intraoral examination:
  - Manipulation of each tooth
  - Check for lacerations
  - Stress the mandible
  - Tongue blade test
- Palpate the mandible for tenderness, swelling and step-off.
Mandibular Fracture Treatment

- Nondisplaced fractures:
  - Analgesics
  - Soft diet
  - Oral surgery referral in 1-2 days

- Displaced fractures, open fractures and fractures with associated dental trauma:
  - Urgent oral surgery consultation

- All fractures should be treated with antibiotics and tetanus prophylaxis → why?

Nutritional Management

Early initiation of enteral feeding

Keep HOB elevated

Evaluate for swallowing dysfunction prior to oral feeding

Wire cutters at bedside at all times
How would you manage this patient?
- Airway protection!
- Control hemorrhage
  - Direct pressure
  - Nasal and oral packing
  - Reduce fractures
- Restore intravascular volume
- Anticipate intracranial injury and need for intervention
  - Serial neurologic exams

Patient and Family Education
- Reinforce surgical plan of care
- Medications
- Nutrition management
- Wound care
- Tracheostomy care
- Avoid direct sunlight for 6-12 months
- Use of cosmetics
- Early referrals to psychiatric liaisons and/or community services
Facial and ocular trauma requires a comprehensive multidisciplinary team to maximize outcomes.

Early incorporation of rehabilitation services is necessary for functional recovery.

Overall prognosis of reconstruction may take months or years.
Musculoskeletal Injuries

Objectives
At the conclusion of this presentation the participant will be able to:
• Identify the initial assessment for patients with musculoskeletal injury
• Describe upper extremity, lower extremity and pelvic musculoskeletal traumatic injuries and implications for nursing care
• Explain indications and strategies for open and closed reduction of fracture/dislocations
• Discuss the prevention, recognition and interventions for compartment syndrome and rhabdomyolysis

Resuscitation
A diagnosis of Musculoskeletal Injury may not occur initially, until there is significant blood loss causing hemodynamic instability.
The Primary Survey in ATLS/ATCN does not include a thorough assessment of musculoskeletal injuries unless gross bleeding causes a concern.
Radiography may/will confirm musculoskeletal injuries.
Prehospital information can help raise the index of suspicion.
Mechanism of Injury (MOI)

How's
What's
Where's
When's

Musculoskeletal Trauma – Initial Management

Blood Loss/Hypovolemia
Pain
Infection
Vascular/Neurovascular Injuries

The four priorities of care

Tourniquets
Pelvic Binder

Quantified Blood Loss

Blood Loss Associated with Fracture in Adults

- Radius and ulna 150–250 ml
- Humerus 250 ml
- Tibia and fibula 500 ml
- Femur 1000 ml
- Pelvis 1500–3000 ml

Acute Pain from Traumatic Injury

- Leads to stress response that increases heart rate and blood pressure
- Limits recovery
- Improved clinical outcome when managed well
Pain Management-General Rules

- Appropriate route for administration of analgesics
- Analgesics should be given at regular intervals
- Analgesics should be prescribed according to pain intensity as evaluated by a scale of intensity of pain
- Dosing of pain medication should be adapted to the individual
- Analgesics should be prescribed with a constant concern for detail

Pain Assessment

- Numeric Scale
- Visual Analogue Scale
- Faces Pain Scale

Current Acute Care Practice

- Strongest Opioid: Severe pain
- Stronger Opioid: Moderate Pain
- Mild Opioid: Mild Pain
Pain

- Standardize medications
- Keep airway resuscitative equipment nearby
- Frequent sensory & motor assessments

Procedural Medications

- Etomidate
- Midazolam
- Propofol
- Ketamine
- Fentanyl

Infection

Infection of bone and bone marrow = osteomyelitis
Infection

Antibiotics are often necessary in the prophylaxis and treatment of orthopedic infections post-operatively.

The characteristics of implantable materials make them a generous host for bacterial colonization.

Vascular Injuries

- Blood vessels can be damaged following a musculoskeletal injury.
- Loss of blood flow to the area of the musculoskeletal injury is called devascularization.
- A vascular injury is the precursor to ischemia.

Neurovascular Damage

Neurovascular injuries include impalement or laceration of nerves of a plexus, leading to a neurologic deficit.

A musculoskeletal injury often involves neurovascular damage because bones lie very close to muscle and nerves.

Neurovascular injuries often occur following a joint dislocation.
Mangled Extremity

Assessment
• Detailed physical assessment
• What is baseline status?
• Are splints applied correctly
• Past Medical History

Diagnostic Studies
• Plain films
• CT, CT angio
• MRI
• Angiography
Dislocations

- Shoulder
- Clavicle
- Sternoclavicular
- Wrist
- Knee
- Hip

Knee Dislocation

Hip Dislocation

Shortened
Externally rotated
Types of Fractures

- Which bone?
- Where in the bone is the fracture?
- Which type/group?

Fracture Classification

- Which bone?
- Where in the bone is the fracture?
- Which type/group?

Grouping - Type A
Grouping - Type B

1. Spiral wedge (42-B1)
2. Bending wedge (42-B2)
3. Fractured wedge (42-B3)

Grouping - Type C

1. Spiral (42-C1)
2. Segmented (42-C2)
3. Irregular (42-C3)

Pediatric Fractures

- Complete
- Incomplete
  - Greenstick
  - Buckle
  - Bow
- Physeal
Fracture Treatment

Simple → pain control, cast

Wedge → closed reduction, cast or surgical repair

Complex → skeletal traction, surgical repair

Types of Fractures

Non-displaced

Displaced
Hare Traction

Indications:

- displaced femur fractures
- often placed by EMS

Skeletal Traction

Indications

- Unstable patient (damage control)
- Preparation for surgery

Reduction

- Reduction is a medical procedure to restore a fracture or dislocation to the correct alignment.
- For the fractured bone to heal without any deformity the bony fragments must be re-aligned to their normal anatomical position.
Internal vs External Fixation

External Fixation

- Indications
- Nursing Responsibilities

Pelvic Fractures

Classification of Pelvic Fractures

Angiographic Embolization

Associated Injuries in Order of Frequency
- Closed head injury
- Long bone fractures
- Peripheral nerve injury
- Thoracic injury
- Bladder
- Spleen
- Liver
- GI tract
- Kidney, Urethra, Mesentery, Diaphragm
SECONDARY INJURIES / COMPLICATIONS

Compartment Syndrome

Capillary Perfusion Pressure: 25 mm Hg 
Interstitial Pressure: 4-6 mm Hg

Etiology

Increased Fluid Content in Interstitial Space
Decreased Compartment Size

http://www.hughston.com/
Signs and Symptoms
- Pain disproportionate to injury!
- Pain with passive stretching
- Neuro compromise
- Tenseness
- Swelling

Pre-op Interventions
- Supplemental O2
- Level extremity
- Hydration
- Diuresis
- Alkalization of urine

Rhabdomyolysis
- Muscle destruction
- Toxic effects
- Adverse drug reactions
Treatment of the Effect of Rhabdomyolysis

- Prevent Acute Renal Failure from the effects of myoglobinuria
  - Monitor CPK, serum and urine myoglobinuria
  - Ensure fluid resuscitation
  - Ensure hyperdynamic urine output
  - Ensure alkaline urine (loop diuretics)
  - Sodium Bicarbonate
  - Dialysis

Deep Vein Thrombosis

- Incidence
- Signs
- Diagnosis
- Prophylaxis

Prevention of DVT is KEY

Medications
- TEDS
- SCDs
- Ambulation
Pulmonary Embolism

- Acute onset of chest pain
- Dyspnea
- Apprehension
- Confusion

Diagnosis
- D-dimer
- V/Q scan
- Pulmonary angiography
- CT Angio

Treatment
- Heparin drip
- Filter placement
- Prevention (same as DVT)

Fat Embolism Syndrome

- Typically after closed fracture of long-bone or pelvis
- 1 to 3 days after traumatic injury
- Many small emboli involved
- SOB, hypoxemia, agitation, anemia/thrombocytopenia, petechial rash (chest, back, neck)
Fat Embolism

- Diagnosis is difficult due to limited signs (other than petechial rash)
  - Symptoms + Sudden fall in Hct / Thrombocytopenia
- Treat symptoms
- Prevent through early immobilization of fracture and O.R. repair

Ongoing Assessments

- Traction does move out of place
- Pins migrate away from initial sites
- Patients re-bleed after surgery
- Immobilization does cause pneumonia and deep vein thrombosis.
- Neurovascular status changes without warning

Summary

- Trauma care begins with standard process for care and destination protocol for pre-hospital personnel
- The initial management of the patient consists of a thorough assessment of the type and degree of injury, and the need for damage control surgery to maintain homeostasis
- Pain management is a critical aspect in the care of the patient with musculoskeletal injury
Summary continued...

• The trauma nurse must be familiar with the types of radiographic studies performed and the need for follow studies in certain situations.

• Multi-orthopedic injuries require different treatment strategies: traction, and open or closed reduction.

• The nurse must identify limb-threatening compartment syndrome and patients at risk for rhabdomyolysis.

• The nurse must protect the patient from infection, which may progress to osteomyelitis.
Chest Trauma Management

Learn & Master ACLS
ACLS-ALGORITHMS.COM

Mechanism of Chest Injury

- Body acceleration and deceleration (organ inertia lags behind skeletal acceleration or deceleration) eg. RTA
- Body compression (force > the strength of skeleton) eg. Crush injury and falls
- Penetrating wounds (open pneumothorax and organ injury) eg. assaults
Animation used at trial for a patient that fell out of bed.
Stab Wounds: Cause of Death

* Most deaths from stab wounds are homicides.
* Homicidal stab wounds are usually multiple, since most wounds leave the victim capable of some resistance for a measurable time during which the thrusts are repeated.
* Single homicidal stab wounds are often associated with drugged, drunk, sleeping, or otherwise partially incapacitated victims and are almost always aimed at the heart.
Surface Trauma

INJURIES FROM HOT & COLD

Cold Injuries
Injuries that can occur even when temperatures are above freezing:
- Hypothermia
- Chilblains
- Immersion Injury (trench foot)

Injuries that occur in below freezing temperatures:
- Frost Nip
- Frost Bite

Hypothermia
What Is It?
“Abnormally low body temperature”
As core temperature drops, there is a progressive decrease in cellular activity and organ function.
Effects of Hypothermia

Progressive decrease in cellular activity and organ function leads to:

- CNS depression
  - weakness, impaired coordination, slurred speech
- Impaired renal function
  - decreased GFR, dehydration
- Respiratory depression
  - hypoxia, acidosis
- Shivering
  - hyperpyrexia
- Hepatic metabolism depression
  - Coagulopathy, effects on glycogenesis
- Cardiovascular irritability
  - dysrhythmias

Manifestations of Hypothermia

Moderate Hypothermia
- Apathetic, lethargic behavior
- Pale, cold skin
- Acetone (sweet, fruity) breath odor
- Shivering

Severe Hypothermia
- Skin is ice cold
- Slow, shallow respirations
- Faint, irregular pulse or lack of detectable pulse
- Glassy eyes
- Confusion
- Unconsciousness

Treating Hypothermia

<table>
<thead>
<tr>
<th>External Rewarming</th>
<th>Internal Rewarming</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PASSIVE</strong></td>
<td><strong>PASSIVE</strong></td>
</tr>
<tr>
<td>warm ambient room temp</td>
<td>warm, humidified oxygen</td>
</tr>
<tr>
<td>remove clothing</td>
<td>warm IV fluids</td>
</tr>
<tr>
<td>cover with dry blankets</td>
<td></td>
</tr>
<tr>
<td><strong>ACTIVE</strong></td>
<td><strong>ACTIVE</strong></td>
</tr>
<tr>
<td>heated blankets</td>
<td>warm peritoneal lavage</td>
</tr>
<tr>
<td>radiant heat lamps</td>
<td>warm GI/GU irrigation</td>
</tr>
<tr>
<td>bair hugger</td>
<td>extracorporeal rewarming</td>
</tr>
<tr>
<td>hot water bottles/heating pads</td>
<td>cardiopulmonary bypass</td>
</tr>
</tbody>
</table>
Rewarming Caution!

Rewarming too rapidly may lead to:
- Cellular swelling and endothelial cell damage
- Coagulopathy
- Thrombosis
- Compartment Syndrome
- Localized tissue ischemia
- Tissue necrosis
- After-drop Syndrome

After-drop Syndrome

Core temperature decreases during the initial rewarming phase, which can lead to death.
- Peripheral vessels in the arms and legs dilate as they are rewarmed.
- This dilation sends cold & stagnant blood from the periphery to the core, further decreasing the core body temperature.
- This blood is also extremely acidic and could lead to dysrhythmias as it is circulated.

Prevention
- Rewarm core only or core & periphery at the same time, avoid rapid rewarming, avoid extreme temperature changes.

Chilblains

Non-freezing cold injury caused by skin exposed to cool, damp climates.

Manifestations
- Acutely red, swollen, hot, tender, and/or itching skin
- Open or bleeding lesions from continued exposure
- Transient numbness and tingling, but painless

Treatment
- Passive rewarming and elevation
- Do not rub or massage; will increase injury to tissue
**Immersion Injury**

- Non-freezing cold injury caused by prolonged contact between wet tissue (hand or foot) and cold temperature
  - Often seen in hunters and soldiers

  **Manifestations**
  - Blisters, swelling, redness, and bleeding

  **Progression**
  - **1st phase**: hand or foot is cold and without pain
  - **2nd phase**: affected limb feels burning hot with shooting pains
  - **3rd phase**: pale skin, bluish coloring around the nail beds and lips, weak peripheral pulses

---

**Treatment of Immersion Injury**

- Dry the affected extremity
- Passive rewarming
  - Remove wet clothing and replace with dry, warm clothing
  - Rewarm the affected area gradually in warm air
- Elevation
  - Do not rub or massage → will increase injury to tissue

---

**Frost Nip**

- Non-freezing injury caused by vasoconstriction secondary to cold exposure

  **Treatment**
  - Passive rewarming

  **Manifestations**
  - Numbness and tingling
  - White, cold skin
  - Underlying tissues remain warm and flexible

  **Affects periphery**
  - Usually fingertips, toes, earlobes, nose, cheeks, & chin
Frost Bite

Destruction of tissues from exposure to freezing temperatures

- Etiology
  - formation of ice crystals in tissue → cellular destruction → tissue necrosis

- Superficial vs. Deep

Superficial vs. Deep Frostbite

<table>
<thead>
<tr>
<th>Superficial Frost Bite</th>
<th>Deep Frost Bite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial frostbite injures the skin and tissues just beneath the skin</td>
<td>Affects muscle, nerves, and blood vessels, may result in tissue death</td>
</tr>
<tr>
<td>- Reddish or grayish discoloration on exposed skin</td>
<td>- Pale, yellowish, waxy-looking skin …or…</td>
</tr>
<tr>
<td>- Often sudden blanching (whitening) of the affected area</td>
<td>- Blue discoloration …or…</td>
</tr>
<tr>
<td>- Excessive swelling</td>
<td>- Black, necrotic tissue/gangrene</td>
</tr>
<tr>
<td>- Tingling sensation and pain</td>
<td>- Tissue becomes solid (feels like wood to the touch)</td>
</tr>
<tr>
<td></td>
<td>- No sensation in the affected tissue</td>
</tr>
</tbody>
</table>

Treating Frost Bite

- Semi-rapid rewarming with strict medical control
- Narcotic analgesia, NSAID’s, antibiotics, tetanus
- Warm IV fluids
- Elevate to minimize edema
- Protected affected area with large, bulky dressing
- Warm blankets (avoid friction or shear on involved tissue)
- Escharotomy
QUESTION?

Nursing measures to prevent hypothermia in the trauma patient include which of the following?

A. Remove wet clothing, administer warm fluids and warm blankets
B. Remove wet clothes, perform peritoneal lavage and use warming lights
C. Provide warm blankets, set up warming lamps, and use cardiopulmonary bypass warming
D. Increase ambient temperature, perform peritoneal lavage, and use warm blankets

Thermal Injuries

First Degree Burns (superficial)

Epidermal layer of skin

Manifestations
- erythema, swelling, pain
- burned area blanches when touched but does not develop blisters

Treatment
- antibiotic cream (Silver Sulfaethionate)
- cool water flush, topical analgesics, NSAID’s
- elevation
- tetanus
Second Degree Burns (partial-thickness)

Epidermal & dermal layer of skin

Manifestations
- Erythema, swelling, extremely painful, fluid-filled blisters develop
- Burned area may blanch when touched

Treatment
- Cool water flush, cleanse thoroughly
- IV fluids & antibiotics
- Topical analgesics, NSAIDs, narcotic pain medications
- Antibiotic cream (Silver Sulfadiazine)
- Non-stick, sterile dressing
- Elevation
- Tetanus
- Possible OR intervention (if circumferential)

Third Degree Burns (full-thickness)

Epidermal, dermal, and deep into sub-dermal (fat) layer of skin

Sweat glands, hair follicles, and nerve endings are destroyed

Manifestations
- Painless, dry/leathery appearance of skin, skin is white, black, or bright red
- Burned area does not blanch when touched

Treatment (depends on severity)
- Cleaning and debriding
- IV fluids & antibiotics
- Antibiotic cream
- Warm, humid environment for the burn
- Nutritional supplements and a high-protein diet
- Tetanus
- Pain medications PRN
- Operative intervention
  - Skin grafting (may be required to achieve closure of the wounded area)
  - Functional (escharotomy if circumferential) and cosmetic reconstruction

Fourth Degree Burns

Full-thickness burn that extends into the fat, fascia, muscle, tendon and bone

Manifestations
- Sweat glands, hair follicles, and nerve endings are destroyed
- Painless, dry/leathery appearance of skin, skin is white, black, or bright red
- Burned area does not blanch when touched

Treatment
- Excision or amputation is common
- All previously mentioned treatments as well
Review of Burns

<table>
<thead>
<tr>
<th>Type of Burn</th>
<th>Population at Risk</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scald</td>
<td>Young children &amp; elderly</td>
<td>Hot liquids, beverages, stove, heated water, tap water, steam, overheating</td>
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<tr>
<td>Flame</td>
<td>Children, adult, &amp; elderly</td>
<td>Flash or flame, clothing ignition, biofuel, cigarettes, flammable liquids, matches, oil</td>
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<td>Contact</td>
<td>Toddlers &amp; adults (occupational)</td>
<td>Direct contact with hot surfaces, stove, lactic acid</td>
</tr>
<tr>
<td>Electrical</td>
<td>Toddlers &amp; Adults (occupational)</td>
<td>High &amp; low voltage contacts, electrical cords, appliances, industrial accidents</td>
</tr>
<tr>
<td>Chemical</td>
<td>Toddlers &amp; Adults (occupational)</td>
<td>Contact with caustic substances, household &amp; occupational chemicals</td>
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What You May See....

Common Burns

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Parkland Formula

- Burn patients required aggressive fluid resuscitation due to rapid fluid shifts and increased vascular permeability

- General indications for fluid resuscitation
  - Burns > 20% of BSA with adults
  - Burns > 10% of BSA with children
  - Age > 65 or < 2

- You do the math... case scenarios....

- Urine output target = 30 – 50ml/hour (adult)
  - 1ml/kg/hour (pediatric)

Nursing Considerations

- Cool saline dressings to burns < 10% TBSA
- Do NOT use ice for cooling
- Cover burns > 10% TBSA with clean, dry sheet (to prevent hypothermia)
- Elevate burned extremities
- Keep patient in warm environment
- IV fluid resuscitation
- Provide analgesia
- Tetanus and antibiotic administration
- Elevate HOB to reduce potential airway edema

Transfer to Burn Center

- Greater than 20% TBSA burns
- Greater than 10% TBSA burns if < 10 years old
- Burns involving face, eyes, ears, hands, feet, genitals, or perineum
- Significant electrical or chemical burns
- Inhalation injury
- Significant comorbidities
CASE STUDIES
Complications of Trauma Across the Life Span

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Pediatric Trauma Care Coordinator

Lynn Motz, MSN, CRNP, ACNP-BC
Surgical Intensive Care Unit

Objectives

Describe:
- Normal Assessment Variables
- Review Management Principles:
  - Case Studies
  - Discuss Complications:
    - Shock
    - Classifications of shock
    - Hemodynamic Profile of Shock
    - Signs & Symptoms of decompensation
    - Management
    - SIRS/Sepsis
    - DITS
    - ARDS
    - MODS

Pediatric Case Study #1

2 yr old – “I found her unconscious after breakfast today – I put her in the shower to revive her,” stated father.

EDH/SDH with mass effect/shift and superior sagittal sinus tear, bilateral parietal fxs and scalp hematomas, mx bilateral rib fxs, pancreatic transection, bruises mx ages, L radius/ulna healing fxs, bilateral retinal heme
Physical Examination

Typical Assessment Order:
- Observe mental status
- Feel for heart rate, pulse quality, skin temperature, capillary refill
- Measure blood pressure early
- Measure urine output later

Physical Examination: Evaluation of responsiveness

ADULTS

Heart Rates in Children

**Infant**

<table>
<thead>
<tr>
<th>Normal</th>
<th>220</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus Tachycardia</td>
<td>SVT</td>
<td></td>
</tr>
</tbody>
</table>

**Child**

<table>
<thead>
<tr>
<th>Normal</th>
<th>180</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinus Tachycardia</td>
<td>SVT</td>
<td></td>
</tr>
</tbody>
</table>
Heart Rates in Adults

Adults
60-100 normal range

- Geriatric population with cardiac conditions may not have a tachycardic response to shock

Physical Examination: Circulation

Evaluation of skin perfusion
- Temperature of extremities
- Capillary refill (consider ambient temperature)
- Color
  - Pink
  - Pale
  - Blue
  - Mottled

Palpation of Central and Distal Pulses
Prolonged capillary refill (10 seconds) in a 3-month-old with cardiogenic shock.

**Physical Examination:**

**Circulation**

Estimate of Minimum Systolic Blood Pressure

<table>
<thead>
<tr>
<th>Age</th>
<th>Minimum systolic blood pressure (5th percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1 month</td>
<td>60 mm Hg</td>
</tr>
<tr>
<td>&gt;1 month to 1 year</td>
<td>70 mm Hg</td>
</tr>
<tr>
<td>1 to 10 years of age</td>
<td>70 mm Hg + (2 × age in years)</td>
</tr>
<tr>
<td>&gt;10 years of age</td>
<td>90 mm Hg*</td>
</tr>
</tbody>
</table>

- Cardiovascular function
  - Heart rate
  - Pulses, capillary refill
  - Blood pressure
- End-organ function/perfusion
  - Brain
  - Skin
  - Kidneys
Physical Examination:
Circulation

Evaluation of End-Organ Perfusion

Kidneys

• Urine Output
  — Normal Child: 1 to 2 mL/kg per hour
  — Normal Adult: 0.5 mL/kg or 30 mL/hr

Initial measurement of urine in bladder not helpful

Evaluate Access: Options

• Intraosseous:
  Allows rapid access
  Sites: anterior tibia, distal femur, medial malleolus, anterior superior iliac spine
  Ages: preterm neonate- adult
  Don’t place in fractured limb
  Blood, fluids, drugs – administer via pressure and follow with NSS flush

Access Options

• Peripheral venous:
  Median antecubital (all) or saphenous sites (kids)
  Follow medications with NSS flush
  Don’t waste time with attempts

• Central Venous:
  Most secure/quick access
  Pressors and hypertonic solutions
  Femoral vein easiest access in emergencies in kids
  Subclavian or IJ more prominent in adults
  Appropriate length/size and skilled providers key
Complications of Trauma: Shock

“A momentary pause in the act of death.”
John Collins Warren

Advanced Trauma Life Support Definitions

Shock: “Inadequate tissue perfusion resulting from inadequate oxygen delivery to meet tissue metabolic demands”

Uncompensated Shock: “Compensatory mechanisms fail to maintain adequate cardiac output and blood pressure”

Types of Shock in Trauma

- Low-flow:
  - Hypovolemic
  - Cardiogenic

- Distributive:
  - Septic
  - Neurogenic
  - Anaphylactic
Causes of Shock

Hypovolemic:
- Burns
- High energy TR to chest/abdomen/pelvis
- Hemorrhage
- Dehydration

Cardiogenic:
- Hypoxemia, acidosis
- Cardiac failure
- Blunt Cardiac/Vascular Injury
- Tension Pneumothorax

Septic:
- Infectious organisms

Neurogenic:
- Anesthesia
- Spinal cord injury
- Severe Brain injury

Anaphylactic:
- Immune or non-immune induced

Clinical Differences

**Hypovolemic Shock:**
- ↑ HR
- Vasoconstriction
- Narrowed pulse pressure
- ↓ BP
- Cool extremities

**Neurogenic Shock:**
- ↓ HR
- Vasodilation
- ↓ BP
- Warm extremities

**Cardiogenic Shock:**
- ↑ HR
- Muffled heart sounds
- Dilated neck veins
- ↑ CVP
- ↓ BP
- ? Tension Pneumothorax
- Absent breath sounds

Traumatic Shock: Blunt

75 ml blood loss
1500 ml blood loss
Several liters
Treatment of Hemorrhagic Shock

1. Stop the bleeding
   • Direct pressure, consider operative control

2. Replace volume loss with isotonic crystalloids
   • Children: 20 ml/kg LR or NSS
   • Adults: 1-2 L LR or NSS
   • 3:1 rule: replace 3 ml for every 1 ml blood loss estimated

What Fluids to Give?

• Crystalloids [start with crystalloids]
  • Ringers
  • Saline
  • Special crystalloids

• Colloids [rule of thumb: start colloids at 15 - 20% blood volume loss]
  • Blood Products
  • Albumin
  • Pentaspan
  • Special colloids
Ongoing Fluid Management

Estimate Maintenance Fluid Requirements:

- Infants under 10 kg: NSS at 4 ml/kg/hr
- Children 10-20 kg:
  - LR or NSS at 40 ml/hr
  - (+2 ml/kg/hr for each kg in range)
- Children greater than 20 kg:
  - NSS or LR at 60 ml/hr (+1 ml/kg above 20 kg)
- Adults: NSS or LR ~ 100 ml/hr
- Elderly: NSS ~100 ml/hr
- Re-evaluate responses to therapy

Responses to Fluid Resuscitation

<table>
<thead>
<tr>
<th></th>
<th>Rapid</th>
<th>Transient</th>
<th>No response</th>
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<tbody>
<tr>
<td>Vital Signs</td>
<td>normal</td>
<td>remain abnormal</td>
<td>(10-20%)</td>
</tr>
<tr>
<td>Estimated Blood Loss</td>
<td>(20-40%)</td>
<td>&gt;40%</td>
<td></td>
</tr>
<tr>
<td>Need for More Crystalloids</td>
<td>low</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Need for Blood</td>
<td>low</td>
<td>med-high</td>
<td>immediate</td>
</tr>
<tr>
<td>Blood Preparation</td>
<td>T&amp;C</td>
<td>Type</td>
<td>Emergency</td>
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<tr>
<td>Need OR Intervention</td>
<td>possible</td>
<td>likely</td>
<td>highly likely</td>
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<tr>
<td>Presence of Surgeon</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

Lesson: assess – treat – re-assess

Treatment of Hemorrhagic Shock

cont.

3. Replace Blood Loss with Blood Products
   - PRBCs provide the best volume expansion and promote oxygen carrying capacity

Massive Transfusion Policy
   “bleeding requiring the need to replace approximately 50% of the patient’s blood volume within a two hour period with continued hemorrhage. Hemodynamic instability in the face of ongoing transfusion may also signal the need to activate the massive transfusion protocol”
Massive Transfusion Protocol

1. Attending physician determines eligibility, estimates weight of the patient and gives the order to the charge nurse/trauma staff nurse to activate the protocol by calling the Blood Bank.

   Send bloodwork immediately: type and crossmatch, Istat, CBC with platelets, electrolytes, PTT/INR/Fibrinogen.

2. For Patient: 10 kg to 20 kg Estimated Blood Volume (80 ml/kg)

   1st pack: 2 units PRBC, 1 unit thawed plasma. (begin thawing 2 units FFP immediately to be released with 2nd pack)

   2nd pack: 2 units PRBC, 2 units FFP, 2 random donor platelets.

   rVita 90 ug/kg (Novoseven) Clinician needs to report the desired dose, so patient weight (kg) x 90 ug/kg = _____ ug.

   • 3rd, 4th, 5th packs: 2 units PRBC, 2 units FFP, 2 random donor platelets, 2-4 units cryoprecipitate.

Classifications and Treatment of Hemorrhage

<table>
<thead>
<tr>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
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<tr>
<td>Blood Loss (ml)</td>
<td>up to 750</td>
<td>751-1500</td>
<td>1501-2000</td>
</tr>
<tr>
<td>Blood Loss (% blood volume)</td>
<td>up to 15%</td>
<td>15-30%</td>
<td>30-40%</td>
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<tr>
<td>Pulse Rate</td>
<td>&lt;100</td>
<td>&gt;100</td>
<td>&gt;120</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>normal</td>
<td>normal</td>
<td>decreased</td>
</tr>
<tr>
<td>Pulse Pressure</td>
<td>normal</td>
<td>decreased</td>
<td>decreased</td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td>14-20</td>
<td>20-30</td>
<td>30-40</td>
</tr>
<tr>
<td>Urine Output (ml/hr)</td>
<td>&gt;30</td>
<td>20-30</td>
<td>less than 5</td>
</tr>
<tr>
<td>Mental Status</td>
<td>anxious</td>
<td>anxious</td>
<td>anxious/confused</td>
</tr>
<tr>
<td>Fluid replacement</td>
<td>crystalloid</td>
<td>crystalloid</td>
<td>crystalloid and blood</td>
</tr>
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</table>

Hemodynamic Response to Shock

<table>
<thead>
<tr>
<th>Percent of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>20</td>
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</table>

Compensated shock | Decompensated shock

Vascular resistance

Cardiac output

Blood pressure
PALS Classification of (Shock) Physiologic Status

Early signs (compensated)
- Increased heart rate
- Poor systemic perfusion
- Narrowed pulse pressure

Late signs (decompensated)
- Weak central pulses
- Altered mental status
- Hypotension

Ongoing Signs and Symptoms of Shock

- Decreased H&H
- Deterioration of PaO2 and pH
- Increasing base deficit
- Diminishing UOP (less than >5ml/kg/hr)
- Increasing Lactate levels

Reversible Shock?

Scene: HR 120 RR 16 GCS 3
ED arrival: HR 60/pulseless Hct 34 INR 1.1
pH 7.19 with BD -8, high lactate
CXR: Bilateral ptx, mx L rib fx

CPR: B Chest tubes CVL 1L NSS
4U PRBC 2U FFP
CT head: hypoxic brainstem right SDH, + midline shift and effaced lateral ventricle.
CT A/P: severe liver and splenic injuries, shattered kidney, blood in the pelvic cavity, a broken pelvis, multiple broken ribs, and free blood within the abdomen, possible Ao injury

OR: 11 U PRBC 9 U FFP NSS
Declared in OR – hypotension, bradycardia
Case Study #1

Pediatric

AB – 8 yr old boy unrestrained passenger - MVC into tree, then rollover. PMH ADHD

08:33: Found 20 ft from vehicle, combative.
GCS 9 HR 92 BVM assisted BP 140/80

Scene: immobilization, intubation, access and fluids- 1L NSS.

09:10: aircraft arrival to HMC ED
GCS 6T HR 140 RR 28, 91% 02 sat BP 149/91

Case Study #1 Injuries:

R scalp de-gloving injury, cerebral contusion, C6-C7 displaced fractures, T2-T3 fractures with cord compression, bilateral pulmonary contusions, R radius fracture, multiple abrasions

Case Study #1 Progression

09:20 – HR 72 BP 128/64 GCS 6 02 100% Noted twitch to UE only. NSS open, warming. CXR confirmed equal bilateral BS, kerlix to wounds

09:26 – CT: HR 95 BP 110/88 GCS 6 02 100%
NSS open. UOP 80cc out

10:15 - MRI: HR 94 BP drifting 88/50 02 88%
L side decreased – suctioned, decreased UOP

Methylpred infusion started, 500cc NSS bolus

12:30 – PICU: HR 100 BP 115/60 UOP brisk
CVL, pigtail left chest, sedation, NSS at 100cc/hr, Norepinephrine infusion, FFP
Case Study: Adult

GK, 51 yr old male who was an unhelmeted motorcyclist, struck by an automobile driving at a high rate of speed.

- 1541: EMS on scene
- Patient was awake initially upon EMS arrival but became unresponsive. He had an obvious near-complete traumatic amputation of his left leg in the mid thigh region with exsanguinating hemorrhage.
- Scene: immobilization, intubation, access and fluids, tourniquet applied
- 1544: Departed scene
- 1603: Asystolic arrest, CPR started
- 1610: Arrived HMC

Case Study: Adult

- 1610:
  - GK was pulseless with CPR in process upon arrival to the trauma bay, left leg with near-complete amputation surrounded by a large amount of blood. He was coded for approx. 25 mins prior to restoration of spontaneous pulses. In addition to the near-complete amputation, he had an intertrochanteric femur fx, & subtrochanteric fx of the left leg, and an unstable APC pelvic injury.
  - GCS 3T; CPR in progress
- PMH:

Case Study: Adult

ED Course:

- 1611: Massive transfusion protocol activated
- 1614: Intubated with 8.0 ETT
- 1620: Right femoral line placed
- 1628: R & L chest tubes placed
- 1636: ROSC, CPR ceased, T 35.4 HR 165 BP 154/68 RR 14 94%, pelvic binder placed
- 1637: epi gtt started
Case Study: Adult

ED Course cont.

• 1645: HR 150 BP 84/61 RR 14 94%
  • Na 156 K 6.4 Cl 107 HCO3 18 Bun 13 Cr 1.2 Gluc 168 WBC 7.12 H/H 10 1/32.1 Plt 61 INR 1.95 PTT AIT 394 AST 416 <6.8/136/40/NC/NC Lactate 10.7

• 1649: HR 154 BP 123/73 RR 14 100%, right chest tube removed & replaced

• 1700: HR 168 BP 108/70 RR 14 95%

• 1701: Transfer to OR

In the trauma bay he had a completion amputation

PRBCs 15 units, FFP 8 units, Fts 3-4pk

Case Study: Adult

1915: Labs

• Na 145 K 5.2 Cl 109 HCO3 17 Bun 13 Cr 1.06 Gluc 234
  WBC 3.2 H/H 8/ 25.31 Plt 134 INR 1.84 PTT 90 fibrinogen
  141 7.18/45/45/16.8/10.9

In the OR:

• 29 units PRBCs, 23 units FFP, 6 units platelets, 315cc cryoprecipitate, and 9000cc LR.

• EBL 6300 cc

• Urine 250 mL

Case Study: Adult

• 1935: Transferred from OR to SICU

  • Chest compressions and code meds given within first 20 minutes. Massive transfusion protocol continues. Epi gtt at ↑ rate. Dr. Galvan, Dr. Sinu & residents @ BS. Patient with large amt bleeding from LLE stump. Automatic tourniquet system from OR applied to decrease bleeding with success. Wife and family at bedside, update given by Dr. Galvan. Abd VAC draining large amt bloody drg. Bilat chest tubes with large drg on right and small drg on left.
  • T36.5 HR 151 BP 78/35 (44) RR 13 98%
  • PCV 100% - 14 – PC 23 - +15 – Vto 700
Case Study: Adult

- 2030: Vaso added @ 0.04 units/min, RIU dialysis catheter placed, CRRT started
- 2045: Norepi added @ 0.2 mcg/kg/min
- 2100: Insulin gtt started @ 5 units/h

Case Study: Adult

- 6/4 @ 0600:
  - Patient with less labile BP. Still requiring continuous fluid (blood products) to keep MAPs >60. Epi, and Vaso gtt's weaned off. Remains on Levophed, Fent, and insulin gtt's. CRRT was initiated overnight and ran without issue until 0600 with filter clotting. Patient received multiple blood products until 0200 in the OR, transfer to ICU, continued massive transfusion protocol: RBCs-73 units, FFP 49 units, platelets 12 doses, nyo 4 units (REVIEWS I&O for total volumes prior to 0200).
- 6/4 @ 0600:
  - T35.9 Hb 91 BP 92/55 (605) HR 18 96%
  - PCV 100% - 18 – PC 22 - +12 – Vte 70B
  - Na 144 K 3.3 Cl 106 HCO3 21 Bun 11 Cr 1.04 Gluc 141 WBC 3.93 H/H 9.8/10.2 Plt 156 INR 1.10 FSP >20 7.37/33/33/19.1/5.4 Lactate 10.7

Case Study: Adult

Injuries:
- Bilateral 1st rib fractures, bilateral small pneumothoraces, bilateral upper lobe contusions, diffuse axonal injury, subarachnoid, intraventricular and subdural hemorrhages, pneumocephalus, left femur fracture, unstable pelvic fracture, skull-base fracture, left T1-T2 transverse process fractures, C1/2 ligamentous injury
Complications of Trauma: SIRS/Sepsis

SIRS/Sepsis Definitions

SIRS: Systemic Inflammatory Response Syndrome
- Systemic inflammatory response to a variety of clinical insults such as: infection, pancreatitis, ischemia, burns, multiple trauma, shock, and organ injury
- Two or more of the following:
  - T greater than 38°C or less than 36°C
  - HR greater than 90 (tachycardia)
  - RR greater than 20 or PaCO2 less than 32 mmHg
  - WBC greater than 12,000 or less than 4,000 or greater than 10% bands

Sepsis
- Same clinical presentation as SIRS with known or suspected infection.

Severe Sepsis

Septic Shock
- Septic Shock: Severe sepsis with hypotension

Systemic Inflammation Physiology

Excessive vasodilatation, increased microvascular permeability, cellular/mediator activation, and accelerated coagulation

- Inadequate Circulating Blood Volume
- Imbalance of Oxygen Supply/Demand
- Altered Metabolism
Systemic Inflammation

↓ Blood Volume (↓ BP/shock):
- Vasconstriction
- Microvascular thrombi/vascular obstruction
- Increased microvascular permeability

↑ Metabolism (↑ HR, ↑ serum glucose, ↑↑ WC/shi ↑↑ ↓Temp):
- Catecholamine stimulation, ACTH/cortisol stimulation
- Carbohydrate, protein and fat stores utilized as energy sources
- Fever/hypothermia
- Increased glucose production/insulin resistance
- Leukocytosis/leukopenia

Oxygen Issues (↓ PaO2/↑ lactate):
- Decreased supply
- Decreased utilization
- Increased demand
- Cellular hypoxia - anaerobic metabolism

Sepsis

SIRS/Sepsis Treatments

↓ Blood Volume
- Stop hemorrhage
- Fluid resuscitate
- Transfuse
- MABP support

↑ Metabolism:
- Monitor electrolytes, correct imbalances (insulin)
- Maintain normo-thermia (warm/cooling blanket, Tylenol)
- Protect compromised host
- Antibiotics (if + infection source)

Oxygen Issues:
- Maximize O2 delivery
- Correct acidosis
- Control pain/anxiety
Case Study: Adult

- Does GK have a SIRS response?
  - Two or more of the following:
    - T greater than 38°C or less than 36°C
    - HR greater than 90 (tachycardia)
    - RR greater than 20 or PaCO2 less than 32 mmHg
    - WBC greater than 12,000 or less than 4,000 or greater than 10% bands
  - 6/3 @ 1630:
    - T 35.4, HR 165, RR 14, PaCO2 136, WBC 7.12
- Does GK have sepsis?

Complications of Trauma: DIC

An acquired coagulopathic syndrome in response to a disease or injury that causes an overstimulation of clotting and anticlotting processes which results in generalized clotting which overstimulates the fibrinolytic mechanisms causing a hypocoagulopathy and hemorrhaging.

Complications: Disseminated Intravascular Coagulation (DIC)

Secondary Process with:

- Over production of thrombin, leading to
- Widespread microvascular thrombosis
- Tissue ischemia
- Hemorrhage

- Triggers: massive tissue/head injury, liver injury, severe acidosis, hypothermia, shock, sepsis, SIRS
DIC

Clinical Signs:
- Low platelet count
- Prolonged PT - clotting factors are consumed, not available
- Overt/covert bleeding
- Dysfunction of kidney, liver, lungs, and CNS common

40-80% mortality

Case Study:
Adult

- Is GK in DIC?
- Low platelet count
- Plt 61
- Prolonged PT - clotting factors are consumed, not available
- PT/INR 22/1.15
- Overt/covert bleeding
- Dysfunction of kidney, liver, lungs, and CNS common

- Na 156 K 6.4 Cl 107 HCO3 18 Bun 13 Cr 1.2 Gluc 168 WBC 7.12 H/H 10.1/32.1 PTT 88 ALT 394 AST 416 <6.8/136/40/NC/NC Lactate 10.7

DIC - Treatment

- Treat the underlying cause
  Rewarm, reverse acidosis, control bleeding
  Reverse the process

- Administer blood products
  FFP 10-15 ml/kg
  Platelets 10 ml/kg – if indicated
Complications: Acute Respiratory Distress Syndrome (ARDS)

- Definition: Severe, acute lung injury with diffuse alveolar damage, increased microvascular permeability and non-cardiogenic pulmonary edema. May occur 2-48 hours after traumatic injury or may take up to 5 days before clinical signs appear.

ARDS: Causes

Direct
- Common causes
  - Pneumonia
  - Aspiration of gastric contents
- Less common causes
  - Pulmonary contusion
  - Fat emboli
  - Near drowning
  - Inhalation injury
  - Reperfusion pulmonary edema

Indirect
- Common causes
  - Severe trauma with shock & multiple transfusions
- Less common causes
  - Cardiopulmonary bypass
  - Drug overdose
  - Acute pancreatitis
  - Massive transfusions

ARDS

- Fluid shifts from capillaries into alveoli, causing localized edema
- Surfactant-producing cells damaged, production decreased
- Alveoli collapse
- Oxygen Exchange severely impaired

NEJM 2000;342,18:1334-1349
ARDS

Clinical signs:
- PaO2/FiO2 ratio less than 200
- Bilateral patchy infiltrates present on CXR
- Decreased pulmonary compliance
- Increased peak airway pressures

ARDS: Treatment

Supportive Treatment:
- Ventilatory support: moderate iTV and PEEP, permissive hypercapnea
- Increased O2 supply – give PRBCs
- Decrease O2 demand – fever and pain management, rotobed, avoid stimulation
- Nitric Oxide - relaxes/dilates pulmonary blood vessels
- Promote CO2 elimination – consider lower carbohydrate formula for enteral feeds
Complications: Multiple Organ Dysfunction Syndrome (MODS)

"Presence of one or more organs with diminished function so that interventions are needed to maintain homeostasis"

MODS Key Points

- Results from secondary injury, “2nd Hit”
  - Infection, DVT, PE, DIC, ARDS
- Up to 70% also have SIRS/sepsis
- Usually begins with respiratory failure, followed by intestinal, hepatic, renal, cardiac systems
- Mortality (60-80%), usually 14-21 days after injury
- Up to 100% mortality with 3 or more organs involved, including kidneys
Case Study: Adult

Risk Factors for ARDS, MODS:
• Severe chest trauma
• Mechanical intubation
• Massive transfusion
• Severe abdomen trauma, including pelvis
• Advanced Age

Case Study: Adult

Does GK have MODS?
• CNS
  • DAI, SAH, & SDH with altered mental status
• Resp
  • PaO2/FiO2: 45/1.00=45 (<200 ARDS)
• CV
  • Requires vasopressors
• Renal
  • CRRT for acidosis, not renal failure
• Liver
  • Elevated transaminases

MODS

Supportive treatment:
• Ventilation, secretion clearance, oxygenation
• Support good cardiac output with medications
• Promote kidney function, may need to adjust medications, fluid/electrolyte balance
• Early feeding via gut, elevated head position to decrease reflux/aspiration
• Treat infection, prevent nosocomial infection-invasive line care, GOOD HANDWASHING
Pediatric Complications 2012 Registry

<table>
<thead>
<tr>
<th>Complication</th>
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<tr>
<td>Coagulopathy</td>
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<tr>
<td>Extremity Compartment Syndrome</td>
<td>2</td>
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<tr>
<td>Soft Tissue Infection</td>
<td>1</td>
</tr>
<tr>
<td>Sepsis</td>
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Adult Complications 2012 Registry

<table>
<thead>
<tr>
<th>Complication</th>
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<tbody>
<tr>
<td>Pneumonia</td>
<td>42</td>
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<tr>
<td>Acute Respiratory Failure</td>
<td>37</td>
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<tr>
<td>UTI</td>
<td>27</td>
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<tr>
<td>Major Arrhythmia</td>
<td>21</td>
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<tr>
<td>DVT</td>
<td>18</td>
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<tr>
<td>Wound Infection</td>
<td>17</td>
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<tr>
<td>Sepsis</td>
<td>16</td>
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<tr>
<td>Iatrogenic Organ, Nerve, Vessel Injury</td>
<td>15</td>
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<tr>
<td>Cardiopulmonary Arrest</td>
<td>10</td>
</tr>
</tbody>
</table>

Complications: Prevention Strategies

- ISB and respiratory care
- HANDWASHING
- DVT prophylaxis
- Early Mobility and turning
- Eyes on all skin surfaces – under braces
- Constant monitoring
- Ownership of your patient – don’t assume someone else will look or do
Critical Care Key Summary Points

- Maximize oxygen delivery
- Rapidly recognize compensating patient before uncompensated
- Gain/maintain venous access and fluid resuscitate
- Reverse coagulopathy
- Promote and protect kidney function
- Assess and re-assess

References

- Advanced Trauma Life Support Course (ATLS)
- Pediatric Advanced Life Support Course (PALS)
- Advanced Cardiac Life Support (ACLS)
- Hazinski, Mary Fran: Nursing Care of the Critically Ill Child, 1992.
Objective

- Describe the perioperative phase as it relates to the operative management of traumatic injury and to predisposition of complications (occurrences).

Trauma Protocols in the OR

- Trauma patients need immediate access to an OR 24 hours a day, 7 days a week.
- Triage is the classification of the seriously injured to the less seriously injured in the event of a large influx of patients.
- Elective surgery may need to be disrupted.
- An OR should be designated for trauma.
What types of injuries cause patients to come to the OR?

Types of Injuries
- MVC
- Falls
- Shootings
- Stabbings
- Blasts/Bombs

Perioperative Nursing Considerations - MVC

Preliminary evaluation: mechanisms of injury (MOI) = kinematics
Include:
- Position of victim in vehicle
- Driver or passenger
- Front or back seat
- Estimated velocity of crash
- Location of impact
Considerations - MVC (cont’d)

Include (cont’d):
- Use of seat belts
- Air bags present
- Ejection
- Entrapment
- Prolonged Extrication

Blunt Trauma

- Result from a combination of forces—acceleration, deceleration, shearing, and compression, that does not break the skin
- Morbidity and mortality may be greater than with penetrating trauma
- Identification of injuries more difficult
- Examples of blunt trauma?
- Most common organ injured?
Falls

- Deceleration forces: stretching, shearing, and compression
- Children: falls greater than twice their height
- Adults: falls greater than 10-15 ft associated with significant injury
- Injury to aorta and skeleton

Penetrating Trauma

- Passage of a foreign object through tissue
- Extent of injury is a function of the energy that is dissipated to the tissue and surrounding areas
- Extent of injury depends on nature of the foreign object
- Examples of penetrating trauma?
- Most common organ injured?
Thermal and Electrical Tissue Damage

- After resuscitation, usually require operative debridement on a non-emergent basis unless limb or life threatening
- Stabilized and transferred to a Burn Center
- Fluid management is most important.

Admission to Perioperative Area

Perioperative nurse may receive a report from the ED nurse with the following information:

- MOI and AMPLE if available
- Status of blood administration
- Spine clearance
- Injuries present
- Surgical consent form may be present; emergency surgery has implied consent

- Team effort/Coordination of Care
Report from the ED nurse (cont'd):
- Amount of fluid received
- Vital signs
- Laboratory and diagnostic test results

The nurse may need to allay fear and anxiety.

Nursing Diagnosis

- Anxiety and fear related to unfamiliar environment
- Fluid volume deficit related to hemorrhage and fluid shifts
- Hypothermia related to rapid infusion of intravenous fluids or exposure
- Pain related to effect of trauma/injury agents

Nursing Diagnosis (cont’d)

- Aspiration risk related to decreased level of consciousness secondary to injury or concomitant substance abuse
- Impaired gas exchange related to ineffective breathing pattern
- Powerlessness related to uncontrolled pain and lack of knowledge
**Outcome Identification**

The patient will:

- experience decreasing levels of anxiety.
- have an effective circulating volume.
- maintain a normal core body temperature.
- experience relief of pain.
- not experience aspiration.
- experience adequate gas exchange.
- experience an increasing feeling of control over the situational crisis.

**Planning**

- Perioperative planning is paramount.
- Equipment, instruments, and supplies that have a high probability of use must be immediately available.
- Auto-transfusion and cell-saving devices are often used if blood salvage is not contraindicated.
- May need to activate MTP

**Implementation**

- Multiple trauma patients often require several procedures simultaneously.
- Collaborative effort is required among the trauma surgeon, anesthesia provider, specialty surgeons, and perioperative nurses.
Implementation (cont’d)

- The order of procedures is determined by the presence or absence of life threats.
- The usual order of priority is chest, abdomen, head, and extremities.
- Simultaneous procedures are preferable to decrease anesthesia time in the critically ill.

Increased Risk for Infection

- Wounds often contaminated
- May have perforated full stomach
- Sterile technique may be compromised secondarily only to immediate life threat
- Antimicrobial prophylaxis – standard of care

Procedure Preparation

- Designated trauma rooms in most facilities
- Emergency instrument sets available
- Considerations when preparing for a trauma case
Auto-transfusion

- Intraoperative blood collected, filtered, and re-infused into the patient
- Provides immediate volume replacement
- Decreases amount of bank blood used
- Reduces possibility of transfusion reactions
- Autotransfusion device: cell-saver

Evidence Preservation

- Injuries of violent crime often have evidence that must be carefully preserved.
- Physical and biologic evidence
- Chain of custody
- Evidence must be documented
A multitude of procedures done.
A specialty-related or stepwise progression is followed in the treatment of primary injuries.
Initially, trauma patients need intensive care with critically ill state.
Secondary wound closure, debridement, and fixations are done on a follow-up basis.
Surgical Interventions
Damage Control Surgery
- Surgical strategy that sacrifices complete, immediate repair of injuries
- Control hemorrhage
- Control hypothermia
- Control contamination
- Intraabdominal packing
- Temporary Closure

Compartment Syndrome
- Swelling of the muscle below the fascia covering. May require fasciotomy.
- Extremity – soft tissue injuries
- Abdominal (Abdominal hypertension) – Causes: Massive intestinal edema, persistent intraabdominal bleeding.
- Can lead to sepsis/multiple organ failure or dysfunction
- Assessment - First 24° critical monitoring
Additional Injuries
Requiring surgical intervention
- head and spinal column
- face
- eye
- neck
- chest and heart
- abdomen
- genitourinary system
- Skeletal injuries

4 top procedures performed due to trauma...
- Craniotomy
- Thoracotomy
- Laparotomy
- Orthopedic
Craniotomy
Evacuation of Hematoma-Subdural and Epidural

Thoracotomy
- Penetrating Trauma
- Blunt Trauma-
  - Aortic Tear
  - Myocardial Contusion

Laparotomy
- Spleen (Blunt Trauma)
- Liver (Penetrating)
- Bowel Injuries
Orthopedic
- Fasciotomy
- Closed Fracture
- Open Fracture
- Debridement

Fasciotomy
- Urgent
- ↑ pressures lead to ↓ perfusion and ischemia.
- Closure may require skin grafting or delayed closure.

Debridement
Resources:

- AORN Guidelines and Recommended Practices
- Alexander's Care of the Patient in Surgery Copyright © 2011 by Mosby, Inc., an affiliate of Elsevier Inc.
- Statistics from HMC Trauma Services
- SurgeryEncyclopedia.com
- Emedicine.com

Questions???
Objective

• Discuss the patient’s response to anesthetic agents in relation to the injury and to operative management.
  – Anesthetics
  – Assessment and monitoring patient response

Types of Anesthesia

• Conscious sedation
• General anesthesia
  – With Endotracheal Tube
  – No ETT
• Spinal/epidural
• Regional blocks
Conscious Sedation

- Patient remains conscious with mood alteration
- Reduces anxiety
- Used for I & D's, line changes, endoscopy, bronchoscopy, cataract surgery
- Versed, valium, fentanyl, and propofol

General Anesthesia

- Reversible state of unconsciousness produced by anesthetic agents with loss of pain sensation over entire body
  - Inhalation agents
  - IV agents
  - Neuromuscular blocking agents
  - Does not always require intubation

Inhalation Agents

- Nitrous Oxide (NO2)
- Forane (Isoflurane)
- Desflurane- maintenance gas
- Sevoflurane
Neuromuscular Blockade

- **Depolarizing:** Succinylcholine (anectine)
- **Nondepolarizing:** Curare-like drugs
  - Pancuronium
  - Atracurium
  - Vecuronium
  - Mivacurium

IV agents

- Opiates
- Anxiolytics

Epidural/Regional/PNB

- Why?
- Who?
- Limitations?
OR to PACU hand off

- Relevant preoperative status
- Anesthesia/sedation technique and agents
- Length of time of anesthesia
- Reversal agents given
- Pain management interventions
- Procedure/s in OR
- EBL and replacement
- Complications with anesthesia
- Emotional status pre-procedure

Hypothermia

- Defined as a core body temperature of 35 C / <96.8 º F
- 60-90% of all patients admitted to the PACU are hypothermic
- Key to treatment is prevention pre and intraoperatively
  - Warm Touch blanket
  - Warmed IV fluids
  - Post-Op: warm blankets, "hot lights", Bair hugger
  - Minimum discharge temperature from PACU is 35 ºC

Phase 1 Recovery

- Time that poses the greatest potential dangers to the patient
  - Vigilance
  - Stable/secure airway
  - Assessment
  - Hemodynamically stable
  - Free from agitation/restlessness/combative behaviors
Phase 1 Recovery Assessment

• VS Q 10 min, I/O, IV site
• Airway
• Pain
• Sedation level
• Comfort level
• LOC
• Sensory and motor function
• Skin: color and condition
• Dressings and incisions
• drains/tubes/catheters
• Pupillary reaction
• Neurovascular

Phase 2 Recovery

• Preparing the patient/family/significant other for care in the home or next level of care

Trauma Happens to Everyone

• Children
• Pregnant women
• Elderly
• The sick
• The impoverished
• Families
References

• Policy Number: P-23CPMN(PeriAnesthesia Standard of Care)


REHABILITATION
Carrie Dunkle RN BSN CRRN
Clinical Nurse Liaison for Adult and Pediatric Rehab at PSHR

Rehab Criteria
- Diagnosis
  CMS vs. non CMS (centers for medicare/medicaid services) - 13 compliant medical conditions
- 3 hours of therapy/day OT/PT/ST
- Recommendations by therapists
- Discharge disposition
- Insurance guidelines

Rehab Team Members
- Patient/family
- Nurses
- Doctors - rehab physiatrists, internal medicine
- Therapists - PT/OT/ST/RT
- Pet therapy
- Care Coordination
- Dietician
- Neuropsychologist
**Treatment Goals**

- Individualized treatment plans
- Education for patients and families on medical conditions, safety, and medications
- Returning the patient to the highest level of independence as possible
- Maximizing mobility skills, ADL’s, communication, cognitive skills, and swallowing skills
- Helping with adjustment to disability and reintegration into community

**Spinal Cord Injury Rehab Protocols**

- Rehab SCI protocol policy
- Bowel and bladder programs
- Sitting programs/skin checks
- SCI book for patients/families
- Education for patients/families
- Family meetings
- Discharge disposition/planning
- SCI is a life changing event/support group/clinic follow ups

**Closed Head Injuries in Rehab**

- Locked brain injury unit
- Ranchos Los Amigos Scale
- Vail beds/restraints/1:1 supervision
- Brain Injury booklet for families
- Education for families
- Family meetings
- Discharge disposition/planning
- Support groups/clinic follow ups
- No coma stim program
Ranchos Los Amigos Scale
Level I
- Complete absence of observable change in behavior when presented with visual, auditory, tactile, proprioceptive, vestibular, or painful stimuli
- Demonstrates generalized reflex response to painful stimuli
- Responds to repeated auditory stimuli with increased or decreased activity
- Responds to external stimuli with physiological changes generalized, gross body movement, and/or not purposeful vocalization
- Responses may be significantly delayed
- Demonstrates withdrawal or vocalization to painful stimuli
- Turns toward or away from auditory stimuli
- Blinks when strong light crosses visual field
- Follows moving object passed within visual field
- Responds to discomfort by pulling tubes or restraints
- Responds inconsistently to simple commands
- Responses directly related to type of stimulus
- May respond to some persons, esp. family/friends, but not to others

Level II – generalized response
- Demonstrates generalized reflex response to painful stimuli
- Responds to repeated auditory stimuli with increased or decreased activity
- Responds to external stimuli with physiological changes generalized, gross body movement, and/or not purposeful vocalization
- Responses may be significantly delayed

Level III – localized response
- Demonstrates withdrawal or vocalization to painful stimuli
- Turns toward or away from auditory stimuli
- Blinks when strong light crosses visual field
- Follows moving object passed within visual field
- Responds to discomfort by pulling tubes or restraints
- Responds inconsistently to simple commands
- Responses directly related to type of stimulus
- May respond to some persons, esp. family/friends, but not to others
Level IV – confused/agitated

- Alert and in heightened state of activity
- Purposeful attempts to remove restraints/tubes or crawl out of bed
- Disproportionate crying and screaming
- Absent short term memory
- May exhibit aggressive or flight behavior
- Mood swings – emotionally labile
- Unable to cooperate with treatment efforts

Level V – confused, inappropriate/non-agitated

- Alert, may wander randomly with intention of going home
- May become agitated in response to external stimuli
- Not oriented to person, place, or time
- Needs extensive redirection
- Briefly converses on a social/automatic level
- Follows simple commands fairly consistently
- Performs previously learned tasks with structure
- Inappropriate verbalization, confabulation

Level VI – confused, appropriate

- Inconsistent orientation
- Better recall of long-term events than recent events
- Follows simple commands consistently
- Verbalizations are appropriate but may be incorrect
- Attends to functional activities for 30 minutes with structure
- Able to use assistive memory aid with maximum assistance
- Moderate assist to problem solve barriers
- Unaware of impairments, disabilities, and safety risks
- Emerging awareness of appropriate response to self, family, and basic needs
Level VII - automatic, appropriate
- Appropriate and oriented but robot-like
- Able to follow a routine schedule
- Minimal supervision for safety in routine home and community activities
- Unable to think about consequences of a decision or action
- Unaware of others needs and feelings
- Unable to recognize inappropriate social interaction behavior

Level VIII - purposeful, appropriate
- Consistently oriented to person/place/time
- Accurate and detailed recall of events
- Functions independently once new tasks are learned
- Adequate judgement and insight, sets realistic goals
- Acknowledges others needs and feelings, and responds appropriately with minimal assist
- Self centered
- Low frustrations tolerance/easily angered
- Able to recognize and acknowledge inappropriate social interaction behavior while it's occurring and takes corrective action with minimal assist

FIMS
- Functional Independence Measurement Score
- Allows for reimbursement
- Used to compare ourselves to other facilities
- Scale 1-7 (dependent to independent)
- Measured in 15 different categories (eating, ADL’s, transfers, bed mobility, ambulation, cognitive status, etc.)
- Scored on admission and discharge
American's with Disabilities Act of 1990

- Title I - Employment
  Prohibits discrimination against people with disabilities in the employment world
- Title II – Public Services
  All state and local governments must be accessible, and intracity public ground transportation
- Title III – Operated Public Accommodations and Services
  Every public facility must be accessible and architectural barriers must be removed
- Title IV – Telecommunications
  Devices must be furnished to hearing and speech impaired individuals

Pediatric Rehab Specifics

- Child life services to assist with activities
- School teacher to help the patient from falling too far behind. Helps to assist with transition back to school
- Social Worker to assist and support families
- Home Ventilator Program
- Independent Care sessions
- Daily team huddles/weekly team conferences

Vent Program

- 4-6 week comprehensive program for pediatric patients only
- For patients requiring chronic or short term ventilatory support
- Intensive teaching for families
- Respiratory Therapy
- Independent shifts of care
Discharge Planning
- Starts on day of admission
- Education for patient/families
- Coordinated by case managers
- Interdisciplinary team meetings
- Patient goal progression
- Insurance reviews
- Family meetings

Community and Financial Resources
- Medical Assistance
- Blue Chip Insurance
- Early Intervention
- United Cerebral Palsy Association
- Children and Youth

Community Support
- Support groups – (SCI, TBI, Stroke)
- Counseling – process can be started by our case management team
- Networking with other families
- Reintegration into the community, Rec therapy to initiate resources
Trauma in the Obstetric Patient

Julie E. Becker, MSN, RNC-OB
Clinical Nurse Educator
Penn State Women’s Health
Objectives

- To identify the normal physiologic changes occurring in the female body during pregnancy.
- To recognize how normal physiologic changes may alter the interpretation of assessment data in the trauma patient.
- To list the initial steps in caring for the pregnant trauma patient.
- To discuss concerns in caring for the pregnant trauma patient beyond the emergency department.
- To examine the resources available to non-obstetric nurses in caring for the pregnant and/or recently delivered patient.
- Identify how the Professional Practice Model reflects the care of the pregnant trauma patient.
- G6 P3114

- How many pregnancies are represented here?

- How many
  - Term?
  - Preterm?
  - Abortions/miscarriages?
  - Living offspring?
OB Terminology

- EDC- Estimated Date of Confinement
- EDD- Estimated Date of Delivery
- FHR- Fetal Heart Rate
- HELLP- Hemolysis, Elevated liver enzymes, Low platelets
- IUGR- Intrauterine Growth Restriction
- NSVD- Normal Spontaneous Vaginal Delivery
- PTL- Preterm Labor
- ROM- Rupture of Membranes
  - SROM- Spontaneous
  - PPPROM- Premature, Preterm, Prolonged
Pregnancy Adaptations

- **Cardiovascular**
  - Hypervolemia
  - Hemodilution
  - ↑ Heart Rate
  - ↑ Cardiac Output
  - ↓ Peripheral Vascular Resistance
  - ↓ Venous Return
  - ↓ Blood Pressure (Nadir 28 weeks)
- Supine hypotensive syndrome
  - Left displacement of the uterus
- Masking of hypotension r/t blood loss
- May require increased blood replacement
- Despite apparent maternal compensation, fetus may be compromised.
Pregnancy Adaptations

- **Respiratory**
  - Thoracic breathing
  - \(\uparrow\) Oxygen consumption
  - Hyperventilation
  - Compensatory respiratory alkalosis
- Liberal use of supplemental oxygen
- Maintain oxygen saturation above 95%
- Hematologic
  - Hypercoagulation
  - ↑ Fibrinogen activity & Factors VII-X, XII
  - ↓ Fibrinolysis
- ↑ Leukocytosis
Trauma Considerations

- Increased risk for thrombosis.
- SCDs and TEDs
- **Gastrointestinal**
  - Organ displacement
  - \(\downarrow\) Gastric motility
  - \(\downarrow\) Stomach emptying time
  - \(\downarrow\) Sphincter tone
  - \(\downarrow\) Gallbladder tone
Risk for aspiration.

- ALL PREGNANT WOMEN SHOULD BE CONSIDERED AS HAVING A FULL STOMACH.
- **Renal**
  - ↑ Glomerular filtration rate
  - ↑ Creatinine clearance
  - ↓ Serum BUN and Creatinine
  - Hydronephrosis
  - Hydroureter
- Bladder more prone to injury and/or rupture.
- Hydronephrosis and hydroureter not necessarily indicative of obstruction.
Pregnancy Adaptations

- **Muskuloskeletal**
  - Pelvic ligaments relax
  - Shift in center of gravity
  - Lordosis
  - Separation of rectus abdominis
Risk for trauma from falls.
- **The uterus**
  - Week 12: Extends out of pelvis
  - Term: Uterine blood flow 500-750 ml/min
Trauma Considerations

- Risk of injury to uterus increases with gestational age.
- Risk of massive blood loss from pelvic injury increases with gestational age.
- Maternal shock = leading cause of fetal demise (Miscarriage/Stillbirth).

- Other outcomes affecting the fetus:
  - Abruption
  - PROM
  - Fetal-maternal transfusion
  - Fetal skull injuries
  - Hypoxia
- Fetal Heart Tones
  - 120-160 beats per minute
  - Assess activity via ultrasound <20 weeks
  - Doppler 20-24 weeks
  - Continuous Electronic Fetal Monitoring >24 weeks for at least 4-6 hours following event
- **Blunt Abdominal Trauma**
  - Motor Vehicle Accidents
  - Falls
  - Domestic Violence/ Assualts
- **Penetrating injuries (Stab & Gunshot wounds)**
- **Burns**
Blunt Abdominal Trauma

- ↓ Bowel injury
- ↑ Hepatic & Splenic injury
  - Watch for upper abdominal pain, referred shoulder pain, sudden onset pain, elevated transaminases
- FAST
- CT
- Peritoneal lavage
- Exploratory laparotomy
Penetrating Abdominal Trauma

- ↓ Maternal mortality
  - Uterus protects lower abdominal organs
- High fetal mortality
- ↑ Small bowel injury with upper abdominal penetrating injury

- Individualized approached based upon point of entry.
- Pregnancy considerations:
  - Elevated diaphragm
    - Place thoracostomy tube at least one interspace higher than usual to prevent inadvertent abdominal placement
  - Pericardiocentesis
Primary Survey
Airway
Breathing
Circulation
Disability (alert, voice, pain, unresponsiveness)
Expose

Initial Therapy
CPR?
Oxygenation (Ventilation)
Volume
Gestational age?

Uterine size <20 weeks
Immediate investigations
Secondary Survey
Pregnancy secondary to other issues

Uterine size >20 weeks
Lateral displacement of uterus
Immediate investigations (fetus alive?)
Pregnancy secondary to other issues
Consider uterine evacuation with unsuccessful resuscitation
Secondary Survey

- Apply liberally: NS or LR
  - Replace 3:1
  - Consider Blood Products
- Asymptomatic until 1500-2000ml blood loss.
- >2000ml blood loss = rapid deterioration.
- Direct Auscultation
- Ultrasound: FAST
Quick Tip!

- Fundal height can provide a rough estimate of gestational age:
  - Top of uterus (fundus) @ umbilicus = 20 weeks gestation.
Team Approach
Mother is the priority

“Pregnancy should not restrict the use of any of the usual diagnostic, pharmacologic, or resuscitative procedures or maneuvers provided to trauma victims.”

(AAP/ACOG Guidelines for Perinatal Care, p 198).
Immediate Investigations

- Imaging studies
- Laboratory evaluations
  - Kleihauer-Betke
- Ancillary exams
  - “Fingers and/or tubes in every oriface.”

“Pregnancy should not restrict the use of any of the usual diagnostic, pharmacologic, or resuscitative procedures or maneuvers provided to trauma victims.”

(AAP/ACOG Guidelines for Perinatal Care, p 198)
- Should we perform diagnostic testing?
- Should we give certain medications?
- Head to toe exam
- More in-depth fetal exam
  - Vaginal Bleeding
  - Ruptured Membranes
  - Preterm Labor
  - Placental Abruption
  - Uterine or Fetal Injury
  - Fetal Distress
Fetal loss correlates with severity of maternal injury:

- Fetal loss with life-threatening maternal injuries: 41%
- Fetal loss with non-life-threatening maternal injuries: 1.6%

But fetal loss *may still occur* without maternal injury.
Abruption

- Placental shearing, fracture or laceration

Signs/Symptoms

- Uterine tenderness
- Uterine contractions
- Vaginal bleeding
- Fetal heart rate abnormality

Management

- Monitor for signs/symptoms
- Continuous fetal monitoring if gestational age >22-24 weeks; Monitor for at least 6 hours
Direct Fetal Injury

- Usually occurs in 3rd trimester
- Blunt abdominal trauma → Fetal skull fracture
Quick Tip!

- Alterations in the fetal heart pattern may be an early indicator of maternal compromise (e.g. hypovolemia).
Figure 37.2: Perimortem cesarean section. (From Katz VL, Dotters DL, Droegemueller W, Pelletier cesarean delivery. Obstet Gynecol 1986; 68: 57.)
Lactation Considerations

- Consider that ALL women of child-bearing age may be planning to breastfeed and/or are breastfeeding a baby at home.
- Assess for feeding preference.
- Initiate Lactation Consult in PowerChart.
- Assist with breast pumping.
- Assess for engorgement.
- Medications: [LACTMED](#)
  - Phone app available.
Collaborative Care

- Emergency Department, Critical Care Areas, O.R., Women’s Health, Neonatal Intensive Care, Lactation, Support Services.
Prevention!

Seat Belts  Domestic Violence

Fall Risk  Depression
- 27 year old female, unresponsive....
- OH, by the way, she is pregnant!
Case Study: L.F.

- 27 year old, G1 PO, 38 6/7 weeks
- s/p MVA vs. Tree
- Entrapment x 20 minutes

History:
- Type I Diabetes
- Chronic hypertension
- Hypothyroidism
Case Study: L.F.

- Unresponsive
- Glucose: 27
- Given 1 amp D50.
- GCS: 14 (after D50).
- Vital signs:
  - P= 90, BP 190/100
Case Study: L.F.

- Collaborative Care:
  - Emergency Department
  - Trauma Surgery
  - Obstetrics
  - Neonatal Intensive Care
- Upon arrival patient was responsive.
- Assessment revealed fetal bradycardia.
- Emergent Cesarean performed in ED.
- Infant was delivered appearing gray and floppy.
- Neonatal resuscitation was performed.
- Infant was transported to NICU and days later went to Newborn Nursery.
- Discharged to home with father and grandmother at seven days of life.
- From ED to OR for exploratory lap following C-Section.
- To ICU on ventilator.
- Assisted with breast pumping by Lactation Consultant.
- Consults by Ophthalmology, Endocrinology, and Psychiatry.
- Tracheostomy due to inability to wean from ventilator.
Upon discharge:

- Tracheostomy tube removed.
- Tolerating regular diet.
- Blood sugar stabilized.
- Transfer to rehab.
Feedback:

- Good teamwork within and among departments.
- A good example of collaboration to optimize outcomes for two patients (Mom and Baby).
- Good communication of the status of mom and baby (per family).
Through collaboration among several departments, we can optimize the level of care and outcomes for two patients and the families and communities of which they are a part.
Nursing Excellence Through Empowerment
- OB Trauma Patients Requiring Treatment in Emergency Department
- Critical Care for the Obstetrical Patient
□ Images

- Seatbelt: http://www.800bucklup.org/parent/images/pregnant%20LapShoulder%20Belt_rev2.jpg
- Life Lion: http://www.hmc.psu.edu/lifelion/photogallery/index.htm
- The Passenger: http://www.dushkin.com/connectext/psy/ch03/plate3.jpg

□ Websites:

- Lactmed:


Pediatric Trauma Overview
TOP 10

Susan Rzucidlo, MSN, RN
Pediatric Trauma Program Manager
Pediatric Trauma Program
Penn State Hershey Children’s Hospital
Milton S. Hershey Medical Center

# 1
An Organized System for Care

Trauma Continuum of Care
EDUCATION
RESEARCH
OUTREACH
Penn State Hershey Children’s Hospital is a Level I Pediatric Trauma Center

Since 1993 the Penn State Hershey Children’s Hospital has been accredited by the Pennsylvania Trauma Systems Foundation as the only Level 1 Pediatric Trauma Center in south central Pennsylvania.

Pediatric Trauma - Under 18 years of age

Pediatric Trauma Centers in PA

- Level I Pediatric Trauma Centers
  CHP, CHOP, St Christopher’s and Penn State Hershey Children’s Hospital
- Level 2 Pediatric Center
  Geisinger Medical Center
  Lehigh Valley Hospital

Pediatric Trauma Program Resources

- Dr’s Cilley, Engbrecht, Rocourt, Santos, Dillon, Fagelman
  Pediatric Trauma Surgeons
- Lynn Simmons and Alissa Bergstresser
  Pediatric Surgery Trauma NP
- Beverly Shirk, BSN, RN
  Peds Trauma Care Coordinator
- Joe Hess, MHA, MS, RN
  Peds Trauma Performance Improvement and Quality Specialist
- Susan Rzucidlo, MSN, RN, CPNP-PC
  Pediatric Trauma and Injury Prevention Program Manager
- Emmy Sasala, Beth Bates & Shannon Kearns-DePatto,
  Health Educators: Injury Prevention Program
- Pediatric Trauma Registrar
Multidisciplinary Trauma Care for the Injured Child

- Pre-Hospital/Emergency Department
- Pediatric Trauma Service (coordination of care/program)
- Anesthesia and perioperative nursing team
- Neurosurgery/Orthopedics
- Pediatric Critical Care Medicine/Pediatric ICU
- Otolaryngology/Plastic Surgery/Ophthalmology/Urology
- Pediatric Nursing: PICU/PICU/7th Floor
- Pastoral Services/Child Life Services
- Pediatric Rehabilitation/Physical/Occupational Therapy
- Support-Radiology, Nutrition, Social Services, Respiratory
- Injury Prevention
- AND MANY MORE !!!

YOU MAKE IT HAPPEN !!!

# 2
A Regional Resource for Pediatric Trauma Care
Where do our patients Come from?
Top 10 Referral Centers in the region.

1. Lancaster General Hospital
2. York Hospital
3. Good Samaritan Hospital
4. Ephrata Community Hospital
5. Memorial Hospital/York
6. Holy Spirit Hospital
7. Carlisle Regional Medical Center
8. Gettysburg Hospital
9. Reading Hospital & Medical Center
10. J.C. Blair Memorial Hospital

YEAR 2008 2009 2010 2011 2012 2013 TOTAL
Lancaster General Hospital 52 28 33 23 28 56 365
Harrisburg Hospital 16 22 27 23 26 28 149
Chambersburg Hospital 16 25 23 16 14 26 119
York Hospital 15 14 17 9 10 14 105
Good Samaritan Hospital 16 9 12 10 8 11 104
Ephrata Community Hospital 15 6 13 9 6 8 89
Reading Hospital & Medical Center 15 7 10 11 6 7 75
Holy Spirit Hospital 16 10 10 11 7 10 67
Carlisle Regional Medical Center 15 7 10 11 7 11 66
Gettysburg Hospital 14 5 12 11 3 4 57
Total 156 149 119 105 104 89 365
PEDIATRIC TRAUMA SCORE
Score less than 8 to a peds center

<table>
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<th>Component</th>
<th>+2</th>
<th>+1</th>
<th>-1</th>
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<td>&gt;= 20 kg</td>
<td>10-20 kg</td>
<td>&lt;10 kg</td>
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<tr>
<td>Airway</td>
<td>Normal</td>
<td>Maintainable</td>
<td>Unmaintainable</td>
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<td>Systolic blood pressure</td>
<td>&gt;= 90</td>
<td>90-60 mmHg</td>
<td>&lt;60 mmHg</td>
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<td>Central nervous system</td>
<td>Awake</td>
<td>Loss of consciousness</td>
<td>Coma</td>
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<tr>
<td>Open Wound</td>
<td>None</td>
<td>Minor</td>
<td>Major</td>
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<tr>
<td>Skeletal</td>
<td>None</td>
<td>Closed fx</td>
<td>Open or multiple fx</td>
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Factors that Affect Transfer and Triage Decisions:
- patient care capabilities
- facility resources
- local politics
- family request
- liability concerns
- insurance networks

Guiding principle: What is best for this injured child
Transfer Guidelines

- Secure airway: low threshold for intubation by most experienced provider
- Secure intravascular access
- Prevent heat loss
- All records & belongings
- Radiology CD and reports
- Family communication

# 3

Appropriate Pre hospital and ED Triage
Mechanisms for Severe Injuries

- Unrestrained in MVC
- Pedestrian struck by car
- Moderate to high falls – 1.5 to 2 X child’s height
- Diving injuries
- Bike crash without helmet
- Handlebar injuries
- Child abuse

MECHANISM OF INJURY

- Varies by age group
- Clues to injuries
- Energy = Injury severity
Developmental Stages

Mechanism and Injury Patterns

Infants

Mechanisms:
- Falls
- Passenger MVC
- Child Abuse

Injuries:
- Intracranial hemorrhage, skull fractures
- Burns/abrasions

Toddlers

Mechanisms:
- Pedestrian/passenger MVC
- Falls
- Child Abuse/Neglect
- Drowning

Injuries:
- Intracranial hemorrhage, skull fractures
- Intra-abdominal Injuries
**Stages and Mechanisms**

**School-aged Child**

**Mechanisms:**
- Pedestrian/passenger MVC
- Bicycle or ATV
- Sports-related

**Injuries:**
- Thorax/abdominal injuries
- Extremity fractures
- Intracranial hemorrhage, facial and/or skull fractures

**Stages and Mechanisms**

**Adolescents**

**Mechanisms:**
- Passenger MVC
- Sports-related
- Firearms

**Injuries:**
- Intracranial hemorrhage, skull/facial fractures
- Thorax/abdominal injuries
- Extremity fractures

**Stages and Mechanisms**

**Teenagers**

**Mechanisms:**
- MVC
- Risk-taking activities
- Firearms
- Sports

**Injuries:**
- Intracranial injury, facial fractures
- Spinal injury
- Thoracic/Abdominal Injuries
- Extremity fractures
Pediatric Trauma Activations

Level 1 - Life and limb threatening

Level 2 – Potentially at risk for serious injury

Level 3 – requires prompt evaluation

- Trauma Room B primary for pediatric trauma
- ATLS model modified for the pediatric patient

---

**PEDIATRIC TRAUMA ACTIVATION CRITERIA**

August 2016

<table>
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<th>CRITERIA</th>
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<th>LEVEL 2</th>
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<tr>
<td></td>
<td>ATLS model modified for pediatric patient</td>
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**#4**

Pediatric Skills and Knowledge

Pre hospital to Rehabilitation
SCENE CARE

- Look for life threatening emergencies
- Locate the family
- Develop a plan of care
- Make it not too scary

EMERGENCY DEPARTMENT CARE

- Look for life threatening emergencies
- Locate the family
- Develop a plan of care
- Make it not too scary
Pediatric Intensive Care Unit

- New CH 18 beds
- Admitted to Pediatric Surgery or Neurosurgery with PCCM concurrent care
- Full-time PCCM specialists
- Protocol management of severe head injuries.

Ongoing In-Patient Care

Pediatric Intermediate Care Unit:
- 18 bed unit, monitoring capabilities

Pediatric General Care Beds: 36 beds
Child Life and Family Services

Rehabilitation: Key to Care

- Pediatric PT, OT, Speech and rehab medicine consulted and treat in acute care
- In-patient pediatric rehabilitation on site
- Out-patient rehabilitation services
- Mild brain injury program
- Nutritional needs
- Developmental Care:
  - Child Life
  - Child Psychiatry
  - Music Therapy
INJURIES ARE NOT ACCIDENTS!

THEY ARE PREDICTABLE AND PREVENTABLE!
TYPES OF INJURIES

- Unintentional
  - Motor Vehicle related
  - Burns
  - Falls
  - Drowning
- Intentional
  - Child abuse
  - Homicide
  - Suicide

PREVENTING INJURIES

- Education
- Engineering
- Enforcement
- Working with Partners

EDUCATION

- Share knowledge
- Easy to do
- May not change behavior
ENGINEERING

ENFORCEMENT

- Reinforce the rules
- Perceived consequence
- Key Partner

Injury Prevention

PARTNERING WITH THE COMMUNITY

- Child Seat Inspection Stations
- SAFE KIDS Walk This Way
- Home Safety
- Shaken Baby Awareness
- Wheel SMART
- Cribs for Kids
- THINK FIRST - brain and spinal cord prevention
- Penn State Concussion Program
- Teen Driver Program
Partners and Programs

Magnet Community Involvement Team

Safety Center - 1st Floor CH

Health Educators
Emmy Sasala
Beth Bates
Shannon DePatto
717-531-SAFE (7233)

# 6
A Comprehensive “PIPS” Program
Overview of the Pediatric Trauma Performance Improvement and Patient Safety Program

Trauma Performance Improvement

- System
  - Resource Allocation
  - Coordination of Care
  - Consistency of Care

- Morbidity and Mortality
  - Provider related
  - Patient injury related
  - Complications
  - Deaths

Pediatric Trauma Continuum of Care

- Patient Outcome
  - Quality of Life
  - Transition to home rehabilitation
  - Patient Satisfaction

Trauma Quality Improvement

- Review of Cases on an ongoing basis
  - Registrar, PI Coordinator, Case Review meeting
  - Integrated with the Organizational Quality Department
  - Integrated with Nursing Units
  - Identify areas for quality improvement
    - Length of Stay
    - X-Ray exposure
    - Coordination of Care
  - Promotion of Patient Safety
The “Performance Improvement and Patient Safety” Mindset

- Improvement, not blame
- Instruction, not recrimination
- “How can we do it better?”, NOT “Whose fault is it?”
- Achieving an objective standard of excellence (outcomes, process, satisfaction)

EVERYONE MAKES GREAT CARE HAPPEN !!!

# 7
Use the Right Equipment

MANY SIZES AND SHAPES
THE RIGHT EQUIPMENT

- Airway Management
- Venous Access
- C spine immobilization
- Catheters – NG, foleys, suction
- Diversions

BROSELOW SYSTEM

- Determine weight of the child
- Size based equipment already together for the resuscitation
- Can travel with you
# 8
Child and Family Centered Care

- Age appropriate interactions
- Age appropriate assessments
- Stranger danger / fears
- Care for the care givers
SUPPORTING FAMILIES IN CRISIS

- Having little or no time to prepare
- Little experience with hospitals
- Loss of control
- Disruption of roles
- Little guidance of what to expect

Family Needs During Crisis

- Five categories:
  - Support and reassurance
  - Information
  - Proximity (visit frequently)
  - To be helpful to loved one
  - Personal needs
- Universal across the age span (neonatal, pediatric, and adult)

Key Aspects of Family Presence

<table>
<thead>
<tr>
<th>Before</th>
<th>During</th>
<th>After</th>
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</table>
| Patient and family screening
  Communicating family's decision to direct care providers and obtaining trauma team leader agreement
  Family preparation
| Facilitate provision of timely information to family
  Provision of support resources including a staff person who is with them
| Family follow-up and support
  Supporting YOU |

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CHILD ABUSE: Child Safety Team

- We are ALL mandated reporters
- Social work on call
- Assessment of injuries
- Investigation – criminal and protective services
- Education

Suspicion of Physical Abuse

- Explanations for an injury inconsistent with pattern or severity of injuries present
- Explanation for injury that is inconsistent with developmental ability of child
- No history, changing history, or conflicting histories for injuries
- Unreasonable delay in seeking care
- Child brought in for non-related complaints and significant injuries is found
- Patterned injuries (bite marks, cigarette burns, welts, linear bruises, step marks etc).
- Multiple injuries at different ages
- Injuries in unusual locations (NOT over bony prominences – eg, buttocks, calves, thighs, back, abdomen, face etc)
- Any bruise or oral bleeding in a non-mobile infant (generally < 9 months)
- Any fracture in an infant < 12 months
- Evidence of previous abuse or unexplained significant injuries, multiple ED visits for injuries
- Accidental pain, bleeding and/or injury in a prepubertal child
- Reasonable suspicion that a child under 15 years of age is sexually active (with a partner of any age)
- Reasonable suspicion that a child under 16 is sexually active with a person 4 or more years older than the child
- Abnormal parent/child interaction
- Caregiver will not allow child to provide responses to questions about history of injury
# 9

ABCDE THE PEDIATRIC WAY !!!

Pediatric Anatomic Differences

- Disproportionate occipital size to body
- Larger body surface area
- Trachea small, larynx more anterior
- Gastric distension less tolerated
- Cartilaginous bone structure and open growth plates
- Abdominal contents below rib cage with less protection from fat

Treatment Considerations

- Tailoring the response to the need
- Appropriate use of resources
- Eliminate unneeded personnel, resources
- Institution specific
- Greatest limitation is accuracy of triage information

Current: Heightened level of readiness for sickest patients
Future: Cost reduction for trauma response
THREATS TO SURVIVAL

RESPIRATORY FAILURE
SHOCK

SECONDARY SURVEY
WHAT ARE THE INJURIES?
TREATMENT PLAN
# 10
THE PEDIATRIC TRAUMA TEAM

YOU MAKE IT HAPPEN !!!

THANKS FOR YOUR ATTENTION
Abdominal Trauma

Anatomy

Penetrating Injury
Impaled

GSW single

Shotgun
Many mechanisms

Splenic injury

CT splenic injury
Hepatic injury

CT Liver injury

Questions?

“ initial of how to solve a problem is by writing it down on a sheet of paper,” —Albert Einstein
Thank You
Objectives:

1. Discuss anatomical and physiological differences of children as it relates to trauma
2. Review injuries and their management

Abdominal Trauma

- Blunt abdominal trauma remains a leading cause of morbidity and mortality among all age groups
- Unrecognized abdominal injury still a PREVENTABLE cause of Death
- Do Not Assume rupture of bowel or bleeding from abdominal organ is easily recognized.

GRACE
Anatomy and Physiology related to Pediatric Abdominal Trauma

- Thin abdominal wall and thin rib cage
- Liver and kidneys lie relatively lower in the abdomen, vulnerable to direct trauma
- Retroperitoneal organs, (liver and pancreas) lie only a short distance away from the anterior abdominal wall
- Liver occupies a large % of the abdominal cavity, further exposing it to injury
- Compact Torsos with smaller A-P diameters

Pediatric anatomical considerations

Physical Exam Components

- Inspection
- Auscultation
- Percussion
- Palpation
Pediatric Assessment

- Ecchymoses (umbilical or flank regions)
- Abrasions
- Tire-tracks
- Seat-belt marks
- Abdominal distension
- Tenderness, rigidity or masses
- Kehr’s sign
- Prolonged ileus (> 4 hours)

Associated Injuries

- Rib fractures: splenic or hepatic injury
- Boys: assess for scrotal injury
- Pelvic fracture: GU, perineal or vaginal injury
- Decreased rectal tone: spinal cord injury

Imaging Studies

Plain films of the chest

- Patient in shock from blunt torso injury with a normal CXR, think intra-abdominal source
- Lower rib fractures indicate risk of liver, spleen injury
- Evidence of diaphragmatic rupture increases the likelihood of associated abdominal solid organ injury; abdomen extends into the lower portion of the thoracic cage, as high as the 4th IC space in children
Imaging Studies

- CT
  - Provides clear and accurate imaging of intraperitoneal and retroperitoneal structures
  - IV contrast provides detail on blood flow/ extravasation
  - Most value with solid organ injury; harder to detect intestinal and pancreatic injury

Solid Organ Injuries

- Spleen is most commonly injured in blunt abdominal trauma
- Liver is next most injured solid organ
- Kidney  Pancreas  Gallbladder
- Liver and Spleen highly vascular, injury can cause fatal blood loss from the parenchyma or arteries and veins that supply them

  *Always consider mechanism of injury*

Solid Organ Injury Protocol

- Hematocrit q 6 hours until stable then q12 or q 24
- Continuous monitor; bedrest depending on grade
- Up walking when Hct stable then repeat Hct after being up
- NPO until stable then ADAT
- Laparotomy/Transfusion if indicated
- Follow up CT discretionary
Liver Laceration
- Most frequent cause of death in children with blunt abdominal trauma
- 90% can be managed non-operatively
- Complications include bleeding, bile leak, infection

Pancreas Injuries
- Less common than spleen or liver
- History of a direct blow to the epigastrium with local pain and tenderness
- Elevated serum amylase and lipase
- CT with fine cuts through the pancreas
- Endoscopic retrograde cholangiopancreatography (ERCP) or magnetic resonance cholangiopancreatography (MRCP) when a major duct disruption is suspected

Pancreatic Injuries
- Injury without major duct disruption (simple contusions or hematomas, elevated lipase and amylase; no evidence of transection
- Injury with major ductal disruption (Obsevation with gut rest and TPN or NJ feeds) proximal ductal stenting; distal pancreatectomy
- Pseudocyst: Anorexia, vomiting, weight loss (Gut rest, TPN, serial ultrasound, or external or internal drainage if persists)
- Management can be difficult
Gallbladder Injury

- Rare
- Most common in blunt trauma
- Frequently associated with other injuries
- Usually missed on CT
- More likely in thin walled or distended gallbladders
- Serial observation vs Cholecystectomy

Genital-Urinary Trauma

**Causes**

- **Penetrating**
  - GSWs
  - SWs
  - Animal bites
- **Blunt**
  - MVC/MCC
  - Seat belt w/ full bladder
  - Falls/straddle injuries
  - Toilet seats
  - Zippers
  - Sex
Kidney Laceration
- Gross hematuria a marker of injury
- 90% renal salvage with non-operative management
- Complications include collecting system disruption

Bladder trauma
- Full bladders more likely to be injured.
- Deceleration injuries: look for both bladder trauma (perforation) and pelvic fractures.
- Persistent hematuria or lower abdominal pain must be further investigated.
- Injuries range from contusion to rupture.

Bladder Rupture
- Gross Hematuria
- Suprapubic abdominal pain
- Inability to void (not definitive)

- Foley Catheter – may need to irrigate if clots are present. WATCH closely
- Surgical intervention may be indicated.

*Always consider mechanism of injury*
GU INJURIES

- Testicular trauma is relatively uncommon, despite the exposed position of the testicles in the male perineum. Injuries typically occur in men 15-40 y/o.

- Traumatic rupture of the penis is relatively uncommon and is considered a urologic emergency.

STRADDLE INJURIES

- Often require colostomy so the area can heal.
- Avoids contamination with stool/urine.
- Infection prevention.
- Pain control.

Hollow viscous Injury

- Stomach
- Duodenum
- Small Bowel
- Colon
Indications for NG tubes

- Gastric decompression (air and food)
- Treatment of ileus or bowel obstruction
- Improves pt discomfort
- Minimizes/prevents recurrent vomiting
- Helps monitor progress/resolution of problem

Contraindications for NG tubes

☐ Check for absence of
☐ nasal/maxillofacial trauma
☐ basilar skull fracture
☐ esophageal pathology (s/p caustic ingestion, stricture, atresia, varices) or recent surgery-at risk for perforation

☐ Placement of an NGT increases risk of elevated ICP
Case G- 8 yo M MVC

POSTOPERATIVE DIAGNOSIS: Pneumoperitoneum and complex free fluid. Right hemothorax.

OPERATION PERFORMED:
1. Exploratory laparotomy.
2. Suture repair of SMV and SMA lacerations.
3. Gastrorrhaphy along the lesser curvature.
4. Partial gastrectomy along the greater curvature.
5. Repair of traumatic abdominal wall hernia on the right side.
6. Partial omentectomy.
7. Right chest tube thoracostomy placement.

IV FLUIDS: 7 units of PRBC, 5 units of FFP, 1.5 liters of crystalloid, 1 pack of platelets.

Traumatic Gastric Perforation
L2 Chance fracture

Life Threatening Decompensation
- Evisceration
- Extra luminal Air
- Ruptured Diaphragm
- Grossly Positive DPL/CT/Ultrasound
- Uncontrolled Hemorrhage
- Sepsis
- Shock
- Penetrating Objects
- Compartment syndrome

Operative Intervention
- Hemoperitoneum in the clinically unstable patient mandates laparotomy
Key Points

- ABC always first
- Children are not just "small adults"
- Outward appearances may be misleading
- Intra-abdominal injuries are not easily recognized
- Skillful assessment and early intervention of intra-abdominal injuries is essential for good outcomes
Physical Abuse and Reporting Guidelines

Kathryn R. Crowell, M.D.
Heather Hoffman

Types of Abuse

Physical Injury
Psychological/Emotional Abuse
Sexual Abuse or Exploitation
Neglect
Imminent Risk

Physical Injury

- “any non-accidental physical injury to the child”
- Abusive Head Trauma
- Fractures
- Cutaneous injuries
  - Bruising
  - Burns
- Abdominal Injury
Psychological/Emotional Abuse

- Injury to the psychological capacity or emotional stability of the child.
- Signs of abuse include: observable or substantial change in behavior/emotional response.

Sexual Abuse and Exploitation

- The involvement of any child in:
  - Any sexually explicit conduct.
  - Any simulation of sexually explicit conduct for the purpose of producing any visual depiction, including photographing, videotaping, and other use of visual materials.

Age of Sexual Activity DOES Matter and you must report

- Any child <13 years old who has engaged in ANY sexual activity (regardless of the partner’s age)
- Any child 13-16 years of age who has engaged in ANY sexual activity with a partner >4 years older.
Neglect

Failure of a parent or other person with responsibility for the child to provide needed food, clothing, shelter, medical care, or supervision to the degree that the child’s healthy, safety, and well being are threatened with harm.

Imminent Risk

➢ When there is an immediate threat of injury or harm to a child and no intervention appears to have occurred, or will likely occur, to protect the child
➢ Acts or failure to act that creates an imminent risk of serious physical injury or sexual abuse and exploitation of a child.

Risk factors for Physical Abuse

➢ Child Factors
  ▪ Prematurity
  ▪ Disability

➢ Parent/child relationship factors
  ▪ Inappropriate parental expectations of child
  ▪ Lack of empathy to child’s needs
  ▪ Physical punishment

➢ Parental Factors
  ▪ Substance abuse
  ▪ Mental health disorder

➢ Family level risks
  ▪ Young, single parents
  ▪ Domestic violence
  ▪ Unrelated adult in home

➢ Social risk factors
  ▪ Low SES
  ▪ Urban location
When to Consider Abuse?

- In any child from any family with any injury when:
  - Multiple injuries to multiple organ systems
  - Denial of trauma in child with significant injury
  - History inconsistent with injury
  - History incompatible with child's development
  - History that changes with time
  - Unexpected and unexplained delay in seeking treatment

Cutaneous Manifestations of Child Abuse

- Abrasions
- Contusions
  - Bruises
  - Hematomas
- Lacerations
- Burns

Do bruises really matter?

- 6 month old male presents for well child visit
- Noted to have two bruises on anterior chest wall
- Family states “that is how his eczema starts”
How would you evaluate bruises?
- Locations and numbers of bruises
- Colors and “ages” of bruises
- Recognizable pattern of bruises
- History of event or injury
- What constitutes abuse?

What causes a bruise?
- Blood vessel ruptures, blood leaks into surrounding tissue, causes local inflammation.
- Appearance depends on:
  - Amount of blood
  - Distance of blood from skin surface
  - Vascularity of tissue
  - Accompanying tissue damage
Bruises

Hematoma

Location of Bruising

Accidental Bruising
- Few in number and small in size
- Occur over bony prominences
- Located on the front of the body
- Most common sites:
  - Lower legs (knees, shins)
  - Forearms
  - Forehead

Abusive Bruising
- More in number
- Occur in unusual locations:
  - Hands
  - Buttocks
  - Face (cheek, nose, ear)
  - Upper arms
  - Chest
### Injury Severity

- Location on the body
- Type of skin
  - face, soles of feet
- How far bone is from the surface of the skin
  - abdomen, shins, elbows
- Consistency of the object
  - soft/malleable, hard/solid
- How fast far the object travels before hitting the body

### Pattern

- High velocity strike may leave a negative imprint
- Blood is pushed away at the point of impact, with breakage of capillaries outlining the object
- Often seen in slap mark; petechiae/contusions occur between fingers

### Slap Mark
Implement Marks

Bite Marks  Kick Marks

Squeeze marks
Burns

- 40,000 children hospitalized each year
- > 2,000 children die annually
- 20% are inflicted burns
- Scald burns
  - Spill/splash
  - Immersion
- Contact burns
- Flame burns
- Electrical burns
- Chemical burns

Burns

- Partial thickness:
  - Reddened skin that blanches (shallow)
  - Clear fluid filled blisters (deeper)
- Full thickness:
  - Leathery dry surface; white, tan, brown, red, black color
  - No pain as nerve endings destroyed

First Degree Burns
Second Degree Burns

Determinants of severity of injury
- Water temperature
- Time of exposure
- Age of child
- Location of injury (type of skin)
- Clothing

Temperature/Time to Burn
- 120 degrees: 10 minutes
- 122 degrees: 5 minutes
- 127 degrees: 1 minute
- 130 degrees: 30 seconds
- 140 degrees: 5 seconds
- 150 degrees: 2 seconds
- 158 degrees: 1 second
Accidental Burns

Spill/Splash burns

Immersion Burns

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Contact burns

Skeletal Manifestations of Physical Abuse

- Frequency of fractures associated with abuse varies from 11-55%
- 43% of injuries are clinically unsuspected
- Multiple fractures are found in over half of physically abused children

Skeletal Survey

- Skull (frontal and lateral) to include Cspine
- Thoracolumbar spine (frontal and lateral)
- Chest (frontal and lateral)
- Extremities
  - Humeri, forearms (frontal)
  - Hands and feet (frontal, oblique)
  - Femora (frontal)
  - Tibias (frontal)
- Pelvis (frontal)
Mechanism of Injury

- Trauma is not often observed
- May be inflicted on more than one occasion by a variety of methods
- Perpetrated by individuals who do not accurately report the mechanism of injury
- Sustained by children who lack the ability to describe what happened.

Types of Forces

- Compression
- Tension: extending or pulling
- Shear: force aligned with surface of structure
- Torsion: twisting
- Bending: force perpendicular to long axis of bone

Fracture Morphology
Fractures: Accident or Abuse?

- Carefully consider:
  - History (type of force)
  - Injury (type of fracture)
  - Time
  - Skin exam
- Abuse more likely when:
  - History inconsistent with injury
  - More than one fracture
  - Fractures in different stages of healing
  - Other signs of abuse

Anatomy of Long Bones

Long Bone Fractures

- Most common fractures in children
- Least specific
- Common fractures not associated with abuse:
  - Supracondylar fracture
  - Spiral fracture of the tibia: “Toddlers fracture”
  - Some spiral fractures of the femur
Fractures Concerning for Abuse

- Classic metaphyseal lesion
- Rib fractures
- Complex skull fractures
- Sternum fracture
- Scapula fracture
- Vertebral fracture
- Fractures in non-mobile infants

Metaphyseal Fracture

- Highly specific for inflicted injury
- Shearing force along the metaphysis, perpendicular to the long axis of bone
- Result from sudden traction on an extremity

Who is a Mandated Reporter?

You are a mandated reporter.

As a PSHMC/PSCOM employee, YOU are a mandated reporter for child abuse.

This means that if you believe a child has been abused, or have reasonable cause to suspect that a child has been abused, you must notify the proper authorities.

The report is made by contacting Childline, 1-800-932-0313
How do you report suspected abuse?

- If you have reasonable cause to suspect that a child has been abused.
  - Call PA Childline: 1-800-932-0313
  - Available 24 hours a day/7 days per week

- Additional steps to consider:
  - Discuss with medical team
  - Consider consult to Child Protection Team

---

CY47

- Fax CY47 to CYS in county in which alleged abuse occurred
- Mail original to CYS
- Anyone can complete this form
- Should be completed within hours of report to childline
- Can be found at http://lookoutforchildabuse.org

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What about HIPAA?

Does NOT apply to situations involving child abuse.

If you have reason to suspect abuse, you are OBLIGATED to report.
What happens if I fail to report?

You will leave a child at risk

Legal Implications for failure to report:
First violation:
$2,500 fine
One year imprisonment
Second violation:
$5,000 fine
Two years imprisonment

Medical professionals risk losing their license or certifications.

What are some common fears about reporting?

- Anxiety about certainty
- Confidentiality
- Retaliation by the family
- Not knowing all the information for CY47

Role of Child Protection Team

- You do NOT need to consult the CPT to report suspected abuse.
- Discuss your concerns with the medical team caring for patient.
- Medical team must request consult with CPT SW or CPT SW and physician.
- CPT can assist in evaluation of children with concerns for suspected abuse, neglect, both inpatient and outpatient.
Questions to ask when making a CPT referral

CPT SW evaluation
- Would in-depth evaluation of home situation and family dynamics be beneficial to this child’s health and safety?
- Would the child/family benefit from additional services beyond discharge?

CPT SW and physician evaluation
- Will a full assessment and review of medical information assist in determining additional steps to assure child’s safety?
- Is the expertise of a CPT physician necessary to determine the possibility of abuse?

Trust your Gut
If you are worried a child has been abused

REPORT

Questions?
Supporting Families after Trauma

Beverly Shirk, RN BSN
Penn State Hershey Children’s Hospital
Pediatric Surgery/Trauma

Objectives:

• Describe family dynamics following
• Explore strategies for child, family, and staff support/communication
• Apply the information to case study family

Characteristics Indicating + Coping Skills/Resiliency

Child:
- Positive temperament
- Above-average intelligence
- Good academic achievement
- Relates well to others
- Participates in activities

Family/Community:
- Family closeness
- Supportive parents
- Adequate rule setting
- Availability of friends and extended family
- Good schools
- Knowledge
Reactions to Crisis

- Infants: vigorous crying - quiet
- Toddler – 5yr: increased crying/clinging, return to younger behaviors, fear separation/darkness
- School-aged (6-11 yr): withdrawal, disruptive behaviors, difficulty paying attention, school/sleep problems, irritability, anger, physical signs
- Adolescent/teen: flashbacks, nightmares, depression, substance abuse, anti-social behaviors, guilt, physical signs

Responses to Crisis

**Physical Signs:**
- Increased HR
- Sweaty palms
- Headache
- Diarrhea / Constipation
- Trembling
- Stuttering
- Shallow breathing
- Dryness of the mouth
- Susceptibility to minor illness

**Emotional Signs:**
- Irritability
- Jealously
- Angry outbursts / Hostility
- Restlessness
- Withdrawal
- Anxiousness
- Diminished initiative
- Over alertness
- Changes in eating habits
- Depression
- Tendency to cry
- Being critical of others
- Reduced self-esteem
- Nightmares
- Insomnia
- Narrowed focus
- Obsessions

**Cognitive Signs:**
- Preoccupation
- Orientation to the past
- Blurred vision
- Forgetfulness
- Lack of concentration
- Decreased coordination
- Attention deficit
- Negative self-esteem
- Lack of control

**Behavioral Signs:**
- Increased smoking
- Under-eating
- Aggressive behaviors
- Aggressive behaviors
- google.com

Factors Impacting Stress Responses

- Person’s perception of the trauma/words
- Age/developmental level
- Little/no time to prepare
- Cause of the trauma
- Reactions of parents, friends, medical team
- Pain and anxiety
- Feeling loss of control
- Limited guidance/supports
- Other social stresses
- Long term impact of injury
- Family member injured or dead
- Pre-existing mental health issues
- Duration of time in crisis
Environmental Sources of Family Stress

• Sights/sounds
• Procedures
• Patient’s appearance and behaviors
• Staff communication and behaviors
• Disruption of normal role/relationship

Initial Coping Strategies

• Immobilization
• Visual Survey
• Withdrawal
• Restructuring
• Intellectualization

Response to Crisis

• Anxiety/shock/fright
• Denial
• Anger/hostility/distrust
• Remorse/guilt
• Grief/guilt
• Hope
Cultural Considerations

- Identify family members, social group supports, customs
- Identify and use accepted communications
- Check usual health practices and remedies

Supporting Strategies

Child

- Comfort - pacifier
- Use warm hands/room
- Swaddle
- Talk gently to them
- Explain what you are doing – be honest
- Touch them, hold hand, smile
- Keep parents in sight

Family

School-aged/Adolescents:

- Allow expressions, accept emotions
- Don’t over-expose
- Reassure timing of parent’s return
- Encourage play
- Allow choices and control
- Explain procedures and treatment rationales
- Set limits/boundaries

Staff
What does this person need at this moment?

Respond to their fears:
• Will it happen again?
• Am I going to die? Did (he/she) die?
• Where is my family? I don’t trust strangers!
• Am I going to be left alone?

Provide Reassurance:
• No fault/blame
• That they are safe

Allow:
• Choices
• Temporary privileges

“Second Trauma”
American Trauma Society Program

“Begin with the end in mind”

• Establish rapport
• Exhibit empathy
• Listen reflectively
• Monitor non-verbal language
• Face emotions

P I L L : Prepare, Inform, Listen, Leave

“Second Trauma”
American Trauma Society Program

• Prepare: where? how? who? deep breath
• Inform: the right message/words, to the right person, with the right body language/tone and attitude
• Listen: don’t interrupt, say less
• Leave: prepare them to see their loved one, role model touch, chair, hand-off
Interventions: Anxiety, shock, fright

• Give honest and brief information
• Repeat and reinforce
• Ask for understanding
• Maintain calm presence
• Maximize some control

“What are you most afraid of?”

Interventions: Denial

• Give direct, factual information

“Based on my experience, I . . .”

Interventions: Anger, Hostility, Distrust

• Recognize before it escalates
• Listen, reframe, diffuse
• Decrease stimulation
• Remain available
• Don’t personalize the emotions
• Set limits – safety
• Get help/back-up
L-A-S-T Technique for Problem-Solving

- Listen to the issue, the reasons given, the feelings expressed, and what would correct the situation for this person.
- Apologize for the situation; respond with empathy.
- Solve the problem together.
- Thank the person for bringing the concern to your attention.

Interventions: Remorse/Guilt

- Do not try to rationalize
- Listen. “I can understand how you might feel that way, however . . .”
- Follow with careful, reality statements: “Kids make their own choices despite what parents may think or want.”

Interventions: Grief and depression

- Acknowledge
- Allow extra time – don’t rush
- Offer to listen or just sit quietly together
- Be aware of your own “unfinished business” and feelings.
Interventions:

Hope

• Ask.
• Support hope that is realistic.
• Offer facts to reframe unrealistic hope:
  “With the information you have, do you think that is still possible?”

What does this family need at this moment?

• Will they die?
• I am not/wasn’t there
• I didn’t . . . .
• I don’t know what to do or how to act
• I heard . . .
• I need . . .

Parent Education:

Interventions for the Parent

• “Take care of yourself” – HALT: don’t get too Hungry, Angry, Lonely, or Tired
• Retreat to calm/quiet places
• Eat healthy foods: stay away from sugar, salt, alcohol/drugs
• Exercise
• Talk with someone you trust – Offer Care Pages
General Care Principles

- Keep child/parent together, or reunite as soon as possible
- Provide understandable information
- Offer suggestions to help meet basic needs: food, clothing, water, showering
- Encourage discussion about care, next steps
- Recognize signs, offer to listen

Patient and Family-Centered Care Elements

- Policies and practices recognize that the family is the constant in the child’s life.
- Families/professionals collaborate on decisions at all levels.
- Diversity is recognized and respected.
- Family-family networking is encouraged.
- Holistic services from injury to home.

Nursing Mutual Participation Model (Curley)

- On admission: recognize parent importance.
- Daily: enable strategies to provide parents information, guidance, and resources.
- Facilitate coping with current stressors.
- Establish caring relationship with parents.
- Assess perception of illness.
- Determine parental goals/expectations.
- Seek suggestions and participation in care.
Supporting the Staff

- Know your “triggers”
- Support sessions
- Ask for what you need
- Keep in touch with families

The E Family

Mom
Comminuted pelvic fx

Dad (LGH)
Severe TBI

Daniel (9y)
Diffuse SDH, SAH with shear, R forehead lac

John (7y)
R temporal depressed fx, bilateral open tib/fib fx

Sarah (5y)
Open-occipital and posterior fx w/traumatic comminution; Open R. subocc, R. parietal, L. ethmoid fxs

Ben (3y)
TBI, basilar skull in scalp bleed, SDH with skull
Challenges

• Entirety of family injured
• Severity of injuries
• Parental Separation (LGH and HMC)
• Communication – language barriers
• Meeting cultural needs
• Coping with deaths of father and siblings

Interventions

• Assign family spokesman – SK
• Ensure constant, timely communication
• Coordinate information flow between facilities – handprint poster, symbolic toy exchange
• Rotate bedside family to promote children coping with injury/care/family separation
• Cohort rooms/bed placement – enable sibling visits
• Coordinate discharge planning
• Coordinate post-mortem requests/needs
THE ROLE OF THE NURSE IN
THE ORGAN & TISSUE DONATION PROCESS

Objectives:
1. Determine the appropriate timing and phone number(s) to be used for making organ and tissue donor referrals.
2. Describe the clinical exam, apnea testing and confirmatory tests for identifying brain death.
3. Describe the optimal family approach process, incorporating three important factors that influence consent.
4. Describe clinical management problems in the organ donor patient.

I. Overview of Gift of Life Donor Program
II. Transplantable tissues
   A. Corneas - Provides sight for those suffering from corneal disease
   B. Skin - Very thin, upper-most layer, used to help burn victims in the healing process
   C. Musculoskeletal - Used in orthopedic surgeries, sometimes for those with loss of limb (donor patient is reconstructed with prosthetics)
   D. Heart valves - Primarily used to replace damaged valves in children
   E. Saphenous veins - Used in heart by-pass grafting

III. Transplantable organs
   A. Heart
   B. Liver
   C. Kidneys
   D. Lungs
   E. Pancreas
   F. Intestine

IV. Legislative initiatives – “Routine referral”
   A. Pennsylvania Act 102 – 1994
   B. CMS Conditions of Participation – 1998
   C. Joint Commission requirements for hospital participation in donation process

V. Death determination: Cardio-respiratory vs. brain death

<table>
<thead>
<tr>
<th>Gift of Life Triage for Patient Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardio-Respiratory Criteria</strong></td>
</tr>
<tr>
<td>• Loss of cardiac function</td>
</tr>
<tr>
<td>• Loss of respiratory function</td>
</tr>
<tr>
<td><strong>Non-Recoverable Brain Injury</strong></td>
</tr>
<tr>
<td>(Ventilator Dependent)</td>
</tr>
<tr>
<td>Brain Death Criteria</td>
</tr>
<tr>
<td>• Irreversible loss of all brain stem &amp; brain stem function in absence of metabolic or pharmacologic inhibitors</td>
</tr>
<tr>
<td>or</td>
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<tr>
<td>• Family is discussing withdrawal of life-sustaining measures</td>
</tr>
<tr>
<td><strong>Potential Tissue Donor</strong></td>
</tr>
<tr>
<td><strong>Potential Organ &amp; Tissue Donor</strong></td>
</tr>
</tbody>
</table>

*Call 1-800-KIDNEY-1*
VI. The referral process for the potential organ donor

A. Call 1-800-KIDNEY-1 (1-800-543-6391) at the first indication of a non-survivable, neurological injury in the mechanically ventilated patient
   1. Prior to withdrawal of hemodynamic and ventilatory support
   2. Regardless of age or medical condition

B. Injuries or injuries that may result in non-survivable neurological injuries
   1. Head trauma
   2. Cerebrovascular accident
      a. Embolic
      b. Hemorrhagic
   3. Non-metastatic brain tumor
   4. Cerebral anoxia or asphyxia
      a. Drowning
      b. Smoke inhalation
      c. Prolonged cardiac arrest

C. Upon referral, Gift of Life will:
   1. Travel to the hospital to evaluate the patient as an organ donor candidate
   2. Communicate with the attending physician upon hospital arrival
   3. Evaluate patient’s chart and clinical course
   4. Determine options for scope of patient/family gift
   5. Contact Department of Motor Vehicles or donor registry to determine patient’s designation
   6. Identify legal next of kin using the Uniform Anatomical Gift Act hierarchy
   7. Collaborate with the hospital care giving team and attending physician
   8. Determine a family communication plan, including no premature mention of donation
   9. Preserve donation options for the family, i.e. DNR status, maintain hemodynamics

Consult Gift of Life on all Vent-Dependent Patients w/a Non-Recoverable Neurologic Injury/Illness

To preserve the organ donation option for patients/families, call 1-800-KIDNEY-1 according to the following criteria:
(regardless of age, medical history, current hospital course, hemodynamic status)

1. At the first indication the patient has suffered a non-recoverable neuro injury/illness (pt. begins to lose some neuro reflexes)
2. Prior to the first formal brain death examination
3. Prior to family discussion of DNR or withdrawal of support
4. Patient has suffered: Head Trauma, Anoxia, CVA

Call Gift of Life – 1-800-KIDNEY-1
(1-800-543-6391)

In collaboration with the care team, Gift of Life will initiate the first mention of organ donation (after it has been determined that the patient is a medically suitable candidate for donation).
VII. Expanded donor criteria
A. Donors > 80 years of age
B. Donors with positive serologies:
   1. Hepatitis B Core Ab+, HCV+
C. Donors with co-morbid factors:
   1. Past medical history of diabetes, hypertension
   2. History of certain cancers, now “cured”

VIII. Two ways organ donation can occur:
A. Donation after Brain Death
   1. Procedure whereby organs are surgically recovered following the determination of
death utilizing neurological criteria; circulation is intact at the time of organ
recovery
B. Donation after Cardiac Death - DCD
   1. Procedure whereby organs are surgically recovered following the determination of
death, by neurological or cardiopulmonary criteria, in the absence of spontaneous
circulation

IX. Identifying brain death
A. Definition – “Irreversible cessation of all brain function, including the brain stem”
B. Clinical exam for brain death (Hospital – specific; please review hospital protocol)
   1. Pupillary reflex
   2. Corneal reflex
   3. Oculocephalic (doll’s eyes) reflex
   4. Oculovestibular (cold or iced calorics) reflex
   5. Pharyngeal and laryngeal (cough and gag) reflexes
   6. Response to painful stimuli
C. Apnea testing
   1. Pre-test guidelines
      a. Clinical exam consistent with brain death
      b. Lack of narcotic, barbiturate or ETOH influence
      c. Hemodynamic stability
      d. Normothermia
      e. EKG, O₂ Sat & BP monitoring
      f. A-line placement

   2. Apnea test procedure
      a. Pre-oxygenate with 100% O₂ & +5 PEEP
      b. Normalize PCO₂
      d. Disconnect ventilator
      e. Administer 6-12 liters O₂ via endotracheal tube cannula
      f. Draw serial ABGs
      g. Observe for spontaneous respirations, BP, dysrhythmias, O₂ sat
      h. Discontinue test if:
         (1) Spontaneous respirations or movement occurs (- apnea test)
         (2) Threatening hemodynamic/oxygenation instability occurs:
            a. Significant hypotension
            b. Severe dysrhythmias
            c. Significant desaturation
      i. If no respiratory effort with a PCO₂ ≥ 60 is observed, this is a + apnea test and
         indicates brain stem death
      j. Reconnect ventilator and titrate settings to optimize ABGs

D. Confirmatory tests
   1. Cerebral blood flow studies; 4-vessel angiography; EEG; Doppler study

X. Family support and communication

---

**5 Phases of Communication with Families of Potential Organ Donors**

**Phase I**
(Serious Injury)
_
 has suffered severe damage to his/her brain. We are doing everything we can but he/she may not recover.

**Phase II**
(Grave Prognosis)

Despite everything we have done, things are getting worse. There is nothing more we can do.

Ensure that Gift of Life has been notified.

**Phase III**
(First Exam)
_
 appears to be dead as there is no brain function. We have begun a series of tests to confirm this. We want to be extremely thorough and careful to ensure that we are absolutely correct.

(Provide the family with information about additional testing and timeframes.)

**Phase IV**
(Pronouncement)
We have finished the testing and found that __________ has died @ _____ (time).

(Where appropriate, repeat clinical exam with the family present.)

Show pictures of CT scan or perfusion scan to help family understand the grave prognosis.

---

**Team Huddle**
Care Team Introduces the Gift of Life Coordinator

**Phase V**
This is __________, a member of our team and a specialist who works with families such as yours.
XI. The family approach and consent for donation

A. Five triggers that may prompt the donation discussion:

B. Three process variables have major influence on consent (See graph below)

1. Appropriate setting: quiet, private environment, away from patient’s bedside
2. Appropriate timing: after family is informed and understands brain death
   a. Decoupled request
      (1) Separation of time between explanation of brain death and the discussion about donation
      (2) Donation discussion takes place only after the family acknowledges understanding that brain death is death
3. Collaborative family approach: Gift of Life coordinator and hospital staff present option of donation together

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**Factors Affecting Organ Donation Consent Rates**

<table>
<thead>
<tr>
<th>Description</th>
<th>Consent Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>When setting appropriate*</td>
<td>67%</td>
</tr>
<tr>
<td>When setting not appropriate</td>
<td>45%</td>
</tr>
<tr>
<td>When request decoupled**</td>
<td>72%</td>
</tr>
<tr>
<td>When request not decoupled</td>
<td>53%</td>
</tr>
<tr>
<td>OPO &amp; hospital staff request</td>
<td>72%</td>
</tr>
<tr>
<td>OPO coordinator request</td>
<td>62%</td>
</tr>
<tr>
<td>Hospital staff request</td>
<td>53%</td>
</tr>
</tbody>
</table>

* Appropriate setting defined as private family consultation room
** Decoupled request defined as a temporal separation between discussion of death and first mention of donation

Source: “Improving the Request Process to Increase Family Consent for Organ Donation”; Gortmaker, et.al. (Journal of Transplant Coordination 1998; 8:210-217)
XII. Clinical Management

A. Management problems
   1. Hypotension – loss of vasomotor tone, inability to regulate blood pressure
   2. Pulmonary complications, impaired gas exchange
   3. Excessive urinary output – diabetes insipidus
   4. Electrolyte imbalance
   5. Hypothermia – inability to regulate body temperature
   6. Cardiac problems

B. Rule of 100: keep SBP >100mm Hg, urine output 100 cc/hr (2-4cc/kg/hr), O₂ sat 100%

C. T4 protocol
   1. Administer via IV bolus, in rapid succession:
      a. Dextrose 50% - 1 ampule
      b. Solumedrol – 2 grams
      c. Regular insulin – 20 units
      d. T4 – 20 mcg
      e. Vasopressin – 1 unit
   2. Initial drip:
      a. 200 mcg T4 in 500 ml NSS. Start with 20 mcg/hr (50 ml/hr)
   3. Considerations
      a. After 30-60 minutes, patient may become tachycardic, with increased body temp & BP
      b. Monitor K⁺ levels: May require increased K⁺ to maintain therapeutic levels
   4. Benefits:
      a. Improved hemodynamic stability
      b. Decreased need for vasopressor agents
      c. Improved oxygenation at the cellular level

XIII. Recovery & preservation of organs

A. Transplant surgical teams come to donor hospital for recovery in most cases
B. Donor hospital provides circulating nurse, scrub nurse, & anesthesiologist or nurse anesthetist
C. Procedure may take 3-6 hours
D. Organ preservation – minimizes cell swelling, prevents intracellular acidosis & helps avoid interstitial expansion

XIV. Benefits of donation

A. Donor family – Helps with grief process; empowers family; brings something positive out of tragic situation
B. Health care professional – Opportunity for continuity of care; brings something positive out of tragic situation
C. Public/Recipients – Medically-effective, cost-effective therapy for end-stage organ failure
XV. Organ donation summary - What you can do to make a difference:

A. Ensure that all ventilator dependent, neurologically injured patients are evaluated for brain death prior to withdrawal of support
B. Provide aggressive medical support of potential organ donors
C. Refer all patients with non-recoverable, neuro injuries early to 800-KIDNEY-1 for evaluation of donation options
D. Ensure that families are receiving constant and simple updates regarding the gravity of their loved one’s condition
E. Ensure that donation is not mentioned to the family until it can be done collaboratively with the hospital staff and transplant coordinator

“Organ donor families have their own stories. Each is different and special. But what is common to all is the uncommon generosity of the human spirit, often in a time of grief and tragedy, to rise above personal self-concern to help others in need of transplantation, in need of life.”

- Rear Admiral Kenneth P. Moritsugu, MD, MPH, Former Deputy Surgeon General of the U.S. -