

Trauma for the Paramedic

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Commotio Cordis



What is Commotio Cordis?

- Latin, “disturbance of the heart”; “commotion of the heart”
- Disruption of heart rhythm as a result of a non-penetrating blow to chest
- Occurs mostly in boys and young men during sports
- Most often caused by a projectile such as a baseball or hockey puck



What Happens?

- Commotio Cordis usually occurs as a result of a blow to the area directly over the heart
- The blow occurs at a critical time during the cycle of a heart beat
 - Typically 10 - 30 milliseconds before peak of T wave.
 - Results in the induction of V fib
- Being less developed, the thorax of an adolescent is likely more prone to this injury
- The myocardium may also be more vulnerable due to an increased heart rate

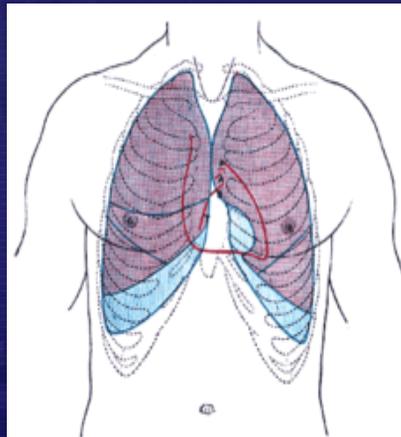


Let's Review:

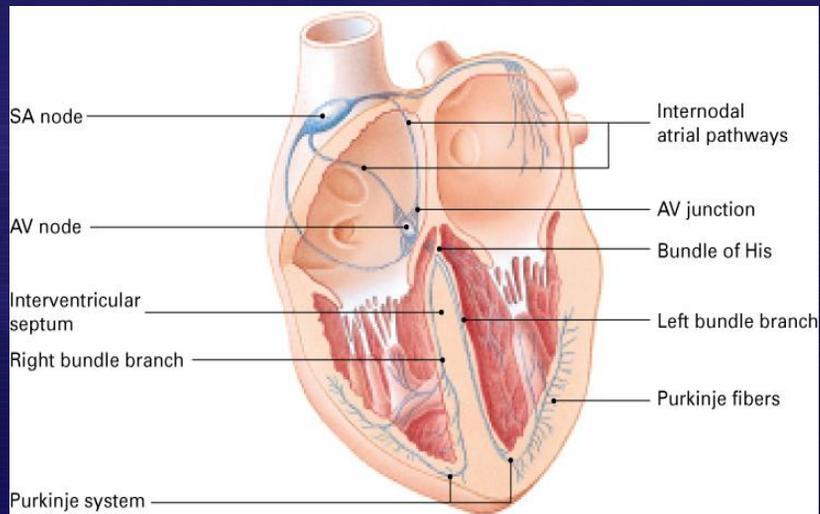


Location of the Heart

- The heart lies in the center of the chest behind the sternum
- The heart tissue is made of specialized cardiac cells
- The heart has it's own electrical conduction system

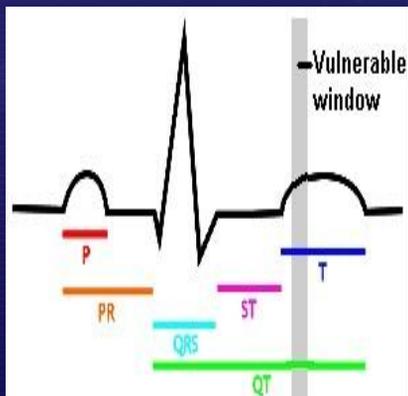


Cardiac Conduction System



Bledsoe, Porter, Cherry, Sawyer, *Intensive Trauma Care*, 1985, Third Edition
 © 2008 by Pearson Education, Inc., Upper Saddle River, NJ

Factors Influencing CC



- Direction of impact over the pericardium (precise area/angle of impact)
- Impact energy of at least 20 joules (30-40 mph)
- Impact occurring within a specific 10-30 millisecond portion of the cardiac cycle
 - Ascending phase of T wave, during repolarization moving from systole to diastole

History

- In most reported cases, witnesses universally believed the trauma was out of proportion to the outcome
- In approximately 50% of cases, immediate collapse occurred
- In remaining cases, a transient period of consciousness was noted with brief but purposeful behavior before collapse



Physical Exam

- Typically found unresponsive, pulseless, apneic; no audible heartbeat, cyanotic
- Grand mal seizures have been evident in some
 - Thought to be related to exercise related hypoxia
- Corresponding chest wall contusions and localized bruising in some cases
- Typically, ribs and sternum are not structurally injured



In the United States...

- Although being reported more often recently, CC still remains a rare event
- More than 188 cases have been reported to the US Commotio Cordis Registry, but many likely go unreported
- According to CC registry
 - Most cases were fatal but survival is up to about 24%
 - 80% are white
 - 95% are male
 - 27% are younger than 10
 - Only 10% are aged 25 or older
 - Average age is 15



Causes Other Than Projectiles



- Blows with elbows, feet, or fists during contact sports
- Children who are punished with blows to chest
- Cases of torture
- Frontal collision MVCs
- Fights



Causes Other Than Projectiles

- CC Registry divided the groups into organized, competitive sports, daily activities, and recreational sports
- Daily activities have included
 - Struck by snowball
 - “remedy” for hiccups
 - Accidental kick during cheerleading
 - Playful boxing



Studies Show:

- During studies, 90% of low impact precordial strikes resulted in immediate v-fib if impact delivered within a 15 millisecond window that occurred 15-30 milliseconds before T-wave peak.
- This window represents only about 3% of the cardiac cycle of individual engaged in activities with heart rate of 120 BPM



In another study...

- ▣ V-fib was reproduced by simulated baseball strikes of 30 mph
- ▣ The force of chest trauma was shown to be inversely related to fatal outcome
- ▣ The hardness of the object striking chest was shown to be directly related to v-fib
- ▣ Softer than normal baseballs reduced the risk of v-fib to
 - ▣ 8% very soft
 - ▣ 22% moderately soft
 - ▣ 29% least soft



Interesting Facts...

- It is estimated that impact energies of at least 20-30 joules are required to cause cardiac arrest
- High impact energy will create structural damage to the heart muscle, electrical upset, and a condition called '*contusio cordis*'
 - Impacts of up to 130 joules have been measured with hockey pucks and lacrosse balls
 - Impacts of up to 450 joules have been measured in karate punches
 - Boxer Rocky Marciano's punch measures 1028 joules



Medical Care

- No different than response to medical cardiac arrest of any origin
- Attention to airway maintenance, ventilation, and chest compressions
- Defibrillation as quickly as possible
- Early bystander CPR has proven to increase chances of survival
- AEDs on site also increase survival; time to defibrillation is single most important determinant of survival



Early Defibrillation

- Data gathered using the CC swine model suggested that defibrillation within one minute of v-fib resulted in 100% survival
- Defibrillation within 2 minutes resulted in 80% survival
- Clinically, out-of-hospital de-fib within 3 minutes produces survival rates in adults greater than 50%
- Every 1 minute delay beyond 3 minutes decreases survival by 10%



Improving Survival

The most effective tools to improve survival rates are increased awareness, education, and available AEDs for the most vulnerable groups. School faculty, coaches, parents, and staff at sporting events should be educated about CC and trained in CPR and the use of an AED



Prevention

- Ages 13 and younger should use age-appropriate safety baseballs
- Chest wall protectors may prevent traumatic injury in some sports, but evidence to promote widespread use is insufficient (evolution of gear?)
- All sports venues should have immediate access (within 5 minutes) to an AED

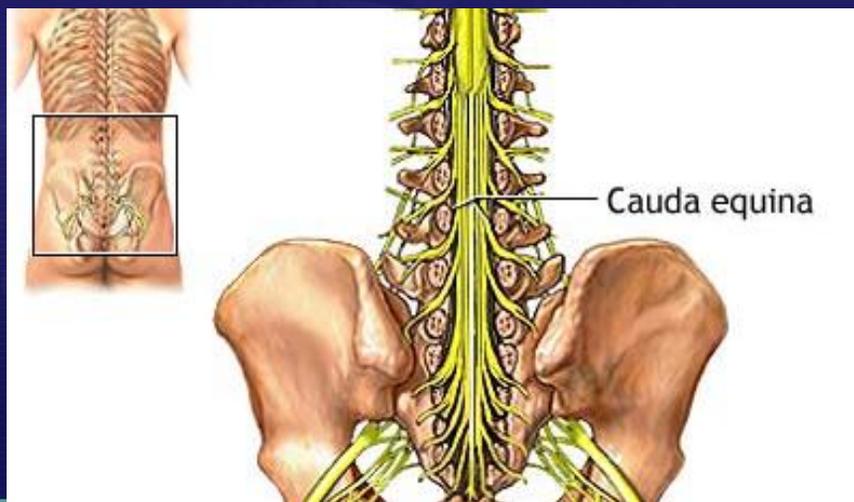


Prevention, con't

- Survivors should undergo a thorough cardiac evaluation and monitoring
- Eligibility for returning to competitive sports following CC episode is a decision left to individual clinical judgment
- Because risk is proportional to the object that strikes the chest, consideration should be given to the use of specially designed (softer than normal) baseballs in recreational and Little League baseball



Cauda Equina Syndrome



What is Cauda Equina Syndrome?

- The Cauda Equina (i.e., Latin for “horse’s tail”) is the name given the group of nerve roots that arise from the spinal cord and extend towards the Cocyx.
- Provides motor innervation to the hips, knees, ankles, and feet...as well as sphincter innervation, sensory innervation to the “saddle region,” and parasympathetic innervation to the bladder and distal bowel.



What is Cauda Equina Syndrome?

Cauda Equina Syndrome is a severe compression or inflammation of the nerve roots descending from the spinal cord that lead to the cocyx.

The Cauda Equina is not the spinal cord but a bundle of nerves that appear like a tail at the end of the spinal cord.



What Happens?

- Cauda Equina Syndrome can result from multiple causes such as:
 - Trauma
 - Herniated Disk
 - Spinal Stenosis
 - Tumors
 - Inflammation
 - Infection



What Happens?

- The most common causes of Cauda Equina in trauma Include:
 - Fractures of the lower lumbar that compress the Cauda Equina
 - Hematomas in the epidural space of the lumbar spine
 - Penetrating trauma to the Cauda Equina.

Physical Exam

- Described in medical literature as presentation of symptoms which includes lower back pain, asymmetrical lower extremity paralysis, variable sensory deficits, and loss of bowel and bladder control
- Major point to keep in mind is this: Cauda Equina Syndrome has a variable presentation and is widely thought to be regularly misdiagnosed or just plain missed.



Key Physical Findings

- The *most common symptom* in patients presenting with CES is **Low Back Pain (LBP)**.
 - >90% of patients
- The *most consistent sign* in cauda equina syndrome is **urinary retention** (incidence approaches 90%)
- “**Saddle anesthesia**” is the *most commonly observed sensory deficit* in patients with CES.
 - Roughly 75% of pts.



Other Possible Findings

- Loss of lower extremity reflexes
- Sexual dysfunction
- Loss of bowel control



What is Saddle Anesthesia?

- Saddle Anesthesia is sensory loss seen around the anus, lower genitalia, perineum, buttocks, sometimes even the posterior thighs.
- It is bilateral vs unilateral
- Think of the body areas that contact a saddle when riding a horse and imagine not having sensation in those areas.



Incidence of Cauda Equina Syndrome

- Incidence of CES in U.S. is estimated between 2 and 4 cases per 10,000 patients with chief complaint which includes LBP.
- High clinical suspicion must be kept in patients presenting with lower back pain and other symptoms. Good history and physical exam-taking is key!



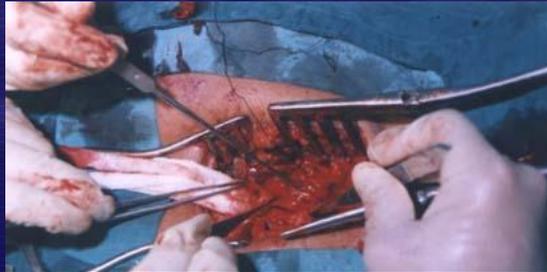
Patient Management

- Implement and maintain spinal mobile restrictions
- A thorough assessment is key!
- Maintain airway & support ventilations as necessary with oxygen
- Provide cardiovascular support with I.V. therapy and possibly pressor therapy.
- Consider anti-inflammatory therapy and use of corticosteroids to reduce swelling.



In Hospital Management

- Urinary Catheters to assist patient in voiding.
- Emergency Imaging
- Surgical decompression of the Cauda Equina.



High Pressure Injection Injuries



What Is High Pressure Injection?

- High Pressure Injection wounds are injections caused by high pressure fluids such as grease, hydraulic fluid, paint, etc. that is injected into the skin and potentially enters muscle or the vascular system.



Common Causes

- Negligent to wear or improper use of PPE can lead to a high pressure injection.
- Typical substances that are injected include:
 - Grease at 5,000-10,000 psi
 - Diesel Fuel at 2,000-6,000 psi
 - Compressed air or water at 6,000-8,000 psi

Pathophysiology

- When a substance is injected in to the skin:
 - Ischemia occurs from lack of oxygen due to inability of injected substance to carry o₂
 - necrosis from high-velocity mechanical impact and type of chemical involved
 - The direct toxic effect of the involved chemical
 - Infection from the unclean fluid.



Physical Exam

- Usually the injection site will be small and needle like to the extremities with the hands being the most common site.
- The left hand is 2x as likely to be damaged vs. the right due to dominant hand in most individuals being the right.
- Fever may be present
- Distended digits
- Swelling to the area



Physical Exam

- excruciating pain
- Inability to move the extremity
- Subcutaneous Emphysema
- Pallor of the extremity



Treatment

- Gather as much info on the injected fluid as possible and contact poison control.
- Maintain airway patency, Support ventilations as necessary with o2
- Support cardiovascular system with I.V. therapy prn.
- Splint the extremity to prevent motion that can cause the injected substance to “travel”
- Provide analgesia per medical direction.
- Transport without delay to trauma facility with access to hand specialist.



This Concludes The Trauma Lecture

