

## Rural & Farm Trauma: Management Concepts



*Managing Competing Priorities*  
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## AirCare MEDEVAC 5



## Objectives

- Farm accident and fatality statics- realization of the problem.
- Challenges these injuries present- the unique difference from urban trauma
- Management considerations- you may have these patients for quite sometime
- Advancements in trauma care- what's on the forefront.

## Agriculture

- 1,823,000 full-time workers production agriculture 2010 (does not account for part timers).
- How many part time farmers?
- 476 farmers died 2010
- On average, 113 youth less than 20 years of age die
- Every day, about 243 agricultural workers suffer "lost-work-time" injury.
  - 5% result in permanent disability

<http://www.cdc.gov/niosh/topics/aginjury/>



## It's a life...

- Farming is one of the few industries in which the families (who often share the work and live on the premises) are also at risk for fatal and nonfatal injuries.

<http://www.cdc.gov/niosh/topics/aginjury/>



## Tractors

- Tractors are the leading cause of death on farms. Around **50% of all deaths** on farms involve tractors.



## Large Animals

- About one-out-of-six farming accidents involves animals
- Animals are the second leading cause of injury on farms



## Farm Bureau reports slight increase in Virginia farm fatalities for 2011

- Tractor overturns accounted for two deaths
- Tractor or other equipment run-overs accounted for two more
- And other tractor or equipment incidents resulted in three
- The organization had no record of 2011 farm deaths from incidents involving animals.
- In 2011, six ATV fatalities were reported to Virginia Farm Bureau.

<https://vafarmbureau.org>

## Caveat to Farm Injuries

- Typically rural setting, far from EMS and Emergency Care
- Involve stronger forces
  - Tractor PTO
  - Equipment weight
  - Large animal forces
- Often “found” and not witnessed
  - Delay in early reporting, GH etc.



## Non-forgiving injuries



## Remoteness presents a large challenge



- Because you will have to care for these patients longer than the usual, urban setting emergency.
- Weather may not be favorable for air medical transport.

## Agricultural & large animal related trauma...

- **Three categories:**

1. Blunt force trauma
2. Penetrating trauma
3. Chemical exposure/asphyxiation



## Blunt force trauma:

- Tractor & equipment roll-overs
- Tractor run overs
- Struck by moving equipment/parts
- Pinned between equipment, hay bales
- Animal kicks, attacks
- Falls from elevated levels



## Blunt force trauma:

- Tractor roll-overs
- Tractor run-overs



ROPS



## Blunt force trauma: Management

- **First thing first...**
- No breathing, no pulse, no organized cardiac activity
  - Blunt trauma arrest on EMS arrival
  - Injuries incompatible with life
  - Evidence of significant time since pulselessness
    - Dependent lividity, rigor mortis, etc.



## Traumatic cardiac arrest...

Traumatic cardiopulmonary arrest survival is rare but some causes are correctable with prompt recognition and intervention.



## Blunt force trauma: Management

- **Airway**
  - Adjuncts
  - Chest decompression
- **Breathing**
  - Adequacy & assistance
- **Circulation**
  - Assessment of pulses and hemorrhage control
- **Disability**
  - AVPU
- **Exposure**
  - Look for multiple injuries



## Blunt force trauma: Management

- **MOI is of significant value!**
  - These are very high forces, expect multiple systems involvement in even the simplest scenarios.
- Un-witnessed injury = unknown time since damage = prolonged compensation.
- **Call for additional resources early:**
  - Specialized trained rescue teams
  - Air medical transport
  - Blood products



## Penetrating trauma

- Control external hemorrhage immediately!
- This is done before airway management.
- Tourniquet use is recommended earlier than previously taught.
- Hemostatic agents increasing popularity (more on this in a bit)



## Penetrating trauma

- **Airway**
  - Adjuncts
  - Chest decompression
- **Breathing**
  - Adequacy & assistance
- **Circulation**
  - Assessment of pulses and hemorrhage control
- **Disability**
  - AVPU
- **Exposure**
  - Look for multiple injuries



## Penetrating trauma

- In farm and machinery related trauma, though it's a penetrating injury, there is likely also blunt force involved.



## Chemical exposure/ asphyxiation

- Multiple chemicals
- Grain bins & silos
- Manure pits
- Other confined spaces



## Chemical exposure/ asphyxiation

- These are specialized rescue events.
- Hazardous materials considerations.
- Often multi-fatality or multi-casualty events.
- Deaths are often "would be rescuers"

2007 - Methane gas accident kills 5 on Virginia dairy farm



- Father in 30's
- Farm worker 24
- Wife 33,
- Daughter 11,
- Daughter 9

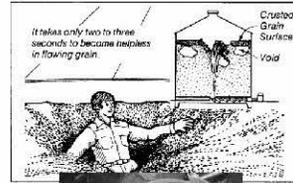
### Chemical exposure/ asphyxiation

- Decontamination
- Identification of exposure
- Antidote administration
- Supportive care:
  - Airway
  - Breathing
  - Circulation
- Transport to appropriate center



### Chemical exposure/ asphyxiation

- Grain bins & silos



### Trauma patient management:

- **Perils of Success:**
  - Emergency care must begin immediately.
  - EMD instructions by dispatchers PTA.
  - Additional resources should be called for early.
  - Do not fall prey to underestimating the situation or patient condition.
  - Recognize the need to involve a trauma center and system early.

### Trauma patient management:

- External hemorrhage control:
  - Stop the loss
  - Use the tourniquets, **carry more than 1!**
  - Consider looking into an carrying haemostatic agents



### Trauma patient management:

- Resuscitate to LOC!
  - Pt mentation is of great value in evaluating resuscitation effectiveness.\*\*
- Basic rules of shock management:
  - Maintain airway
  - Maintain oxygenation and ventilation
  - Control bleeding where possible
  - Maintain circulation
    - Adequate heart rate and intravascular volume

### Crushing Forces

- 2 variables involved
- **Pressure & Time**
  - High Pressure, Short Duration (<1hr)
    - Results in fractures and compartment syndrome
  - Low Pressure, Long Duration (>1hr)
    - Commonly produces crush syndrome
  - High Pressure, Long duration
    - Produces amputation



### Trauma patient management:

- Crush syndrome 
  - AKA traumatic rhabdomyolysis or Bywaters' Syndrome
  - Syndrome was discovered by British physician Eric Bywaters in patients during the 1941 London Blitz
  - Typically affected areas of the body include lower extremities (74%), upper extremities (10%), and trunk (9%).
  - rhabdomyolysis releases potassium, myoglobin, phosphate, thromboplastin, creatine and creatine kinase.

### Trauma patient management:

- Crush syndrome 
- Clinical Presentation:
  - Treat for crushing weight of 1 hr.
    - Initially, 15 min (1941).
    - Expect adverse outcomes greater than 4hrs.
  - Peaked T waves, wide QRS, lengthening QT interval, loss of P wave)
  - MOI may be your only indication in an entrapped patient.



### Trauma patient management:

- Crush syndrome 
- Systemic sequelae of crush injury:
  - Result from death of muscle cells and leak of intracellular metabolites into systemic circulation
  - May not manifest until just after entrapment is resolved.
    - Hypovolemia
    - Hyperkalemia
    - Hypocalcemia
    - Hyperphosphatemia
    - Metabolic acidosis
    - Myoglobinemia/myoglobinuria



### Trauma patient management:

- Crush syndrome 
- Permissive hypotension is unwise
- Treat prophylactically, however do not delay rescue.
- Initial Management:
  - High flow oxygen
  - IVF bolus (20mL/kg of NS, avoiding LR)
  - 1mEq/kg sodium bicarbonate in 1L NS over 2 min
  - Continuous albuterol nebulizer
  - 8mg/kg calcium chloride 10% over IV over 5 min (double for calcium gluconate)- controversial

### Trauma patient management:

- Crush syndrome 
- Advanced care concepts:
  - Regular insulin 5-10 U IV
  - 50% glucose, 25-50g IV
  - Kayexalate 25-50g with sorbitol 20% 100mL by mouth or rectum
  - Mannitol (controversial)
  - Even so, cardiac arrhythmias may develop; electrocardiographic monitoring is advised, and specific treatment begun promptly.

### Perfusion

- Forget blood pressure parameters...
- Learn MAP (mean arterial pressure)
- Term used in medicine to describe an "average" blood pressure in an individual
  - $MAP = [(2 \times \text{diastolic}) + \text{systolic}] / 3$

## Perfusion

- An MAP of about 60 is necessary to perfuse coronary arteries, brain, kidneys.
- Usual range: 70-110 mmHg
- This is important when we have patients with uncontrollable internal hemorrhage.
- Excessive MAP = Increased hemorrhage.
- Fluid resuscitation should be titrated to MAP
- This is what “permissive hypotension” is about

## Permissive hypotension

- Study by Sondeen et-al investigated pressure to induce bleeding (on pigs).
  - Reliable data revealed SBP of 94 mmHg
  - Several other studies support those findings
- Putting this data together, it is reasonable to attempt at target SBP of 70 - 90 or a MAP near 65.
  - $84/56 = \text{MAP } 65.3$

## IV Fluid Administration

- **Uncontrollable hemorrhage**
  - May increase bleeding and death
  - Dilutes clotting factors
  - Early blood transfusion in severe cases
    - IV fluids carry almost no oxygen
  - Moribund trauma patients
    - Fluid may be indicated to maintain some circulation
  - Local medical direction



## IV Fluid Administration

Where we are learning a lot:



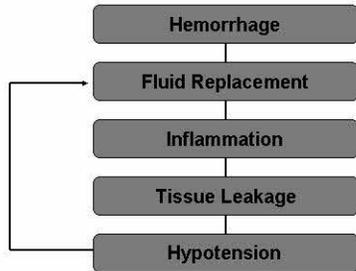
## “Resuscitation injury”

- In the setting of trauma, capillary permeability increases, = a loss of intravascular fluid into the interstitial space.
- Treating these patients with large volumes of crystalloids can lead to cellular swelling and resulting dysfunction.
- This inflammatory response may create a vicious cycle where “...fluid overload and edema beget further fluid replacement and worsening edema.”

## “Resuscitation injury”

- In the Vietnam War:
  - clinical entity of acute lung injury characterized
  - called “Da Nang Lung,” after the Navy field hospital in Vietnam where it was frequently seen
  - later became known as adult respiratory distress syndrome (ARDS)
  - Then “acute” respiratory distress syndrome
  - Although never clinically proven that crystalloid resuscitation causes ARDS, the link is very concerning

## “Resuscitation injury”



## “Resuscitation injury”

- How to we avoid it?



Differential Diagnosis For Shock In Trauma	
Etiologies of Shock In Trauma	Associated Physical Examination Clues
Hemorrhage/vol loss	Narrow pulse pressure, slowing of external bleeding without intervention
Tension Pneumothorax	Deviated trachea, absent unilateral BS, JVD, narrow pulse pressure, pulsus paradoxus
Pericardial Tamponade	Beck's triad: JVD, muffled heart sounds, narrow pulse pressure, pulsus paradoxus
Myocardial Contusion	Tachycardia out of proportion to other injuries, abnormal EKG, or cardiac enzymes
Neurogenic Shock	Spinal injury above T6, bradycardia, warm extremities

## “Resuscitation injury”

- Approximately 7% of traumatic death is caused by organ failure, typically multiorgan or ARDS.
- Therefore, hemorrhage mortality can be related to both exsanguination and resulting inflammatory and immunologic processes.
- In other words: **“trauma is an immune disease”**.

www.ebmedicine.com

## “Resuscitation injury”

It has been recognized since World War I that resuscitation in the absence of bleeding can be harmful.

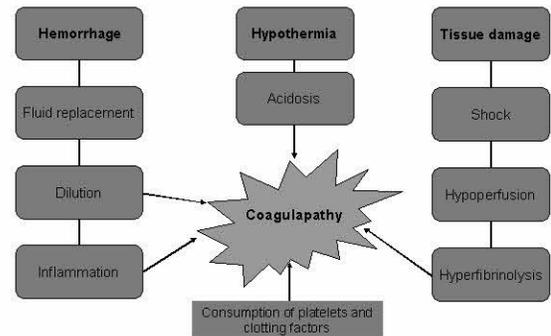


Cannon WB. The preventative treatment for wound shock. JAMA 1918; 70(9): 618-621. (Guideline)

## “Resuscitation injury”

- Seminal studies done in 1950's by Wiggers and others showed good outcomes in aggressive resuscitation.
- Problems with study:
  - Done on animals with “controlled hemorrhage”
  - Did not take into consideration aspect of soft clots and increased volume dislodging them.
  - More of a postoperative approach rather than emergent resuscitation.

## “Resuscitation injury”



## Tranexamic Acid (TXA)

- An amino acid derivative used to control menstrual cycle bleeding and surgical bleeding.
- **CRASH 2**- Study in 2010: 274 hospitals, 40 countries, 20211 patients.
  - Given to trauma patients in first 8 hours
  - Greatly reduced all-cause mortality
  - As a consequence, many trauma centers are using TXA.

## Traumatic Brain Injury (TBI)

- There is no tolerance for hypotension in this patient population.
- Airway and oxygenation are key to survival.
- Avoiding hypoxia: SPO2 & ETCO<sub>2</sub>.
- Only hyperventilate signs of herniation.
- Intubation and airway control is paramount.



## Capnography

- Provides information about both, **ventilation** and **perfusion**
- Promptly identifies ROSC during CPR, and effectiveness of pacing.
- Provides a status in obtunded patients when LOC is altered
- Indicator in treatment of shock
- Has been the gold standard in intubated pts, now is with any pt with ALOC.

## Capnography

- Level of exhaled CO<sub>2</sub> as waveform (ETCO<sub>2</sub>)
  - Typically ~35–45 mmHg
- Falling ETCO<sub>2</sub>
  - Hyperventilation or decreased oxygenation
- ETCO<sub>2</sub> <20 mmHg
  - May indicate circulatory collapse
  - Warning sign of worsening shock



## Special note:

- Do not discount a single hypotensive blood pressure reading as an “error”.
- This is reliable indicator that the patient is compensating.
- This event should be noted, and warrants an immediate reassessment.



## Summary

- Trauma associated with farm equipment should be approached with heightened suspicions. MOI
- Rural setting = long transport time = long term care considerations.
- Call for additional resources early
- Beware of BAA (big ass animals)

### Summary

- Importance of ABC is still the same, except go for the **heavy bleeder first**.
- Carry more than 1 tourniquet.
- Think MAP numbers rather than SBP/DBP and that 65 mmHg will do the job.
- Give consideration to the amount of IVF given in a non-hypotensive patient.

### Summary

- Think “crush syndrome” in entrapped patients who are “found”
- Do not disregard a single hypotensive episode.
- Traumatic brains require adequate resuscitation and there is **nothing** hypotensive about that patient population.

### Summary

- Mentation & LOC is key in evaluating resuscitation.