Crush Syndrome Trauma

History
- Entrapped and crushed under heavy load > 30 minutes
- Extremity / body crushed
- Building collapse, trench collapse, industrial accident, pinned under heavy equipment

Signs and Symptoms
- Hypotension
- Hypothermia
- Abnormal ECG findings
- Pain
- Anxiety

Differential
- Entrapment without crush syndrome
- Vascular injury with perfusion deficit
- Compartment syndrome
- Altered mental status

	Age Appropriate Airway Protocol(s) AR 1, 2, 3, 4, 5, 6, 7 ***as indicated***
B	12 Lead ECG Procedure CSP 1
	IV / IO Access Protocol UP 6
P	Cardiac Monitor
	Multiple Trauma Protocol TB 6 ***if indicated***
	Thermal Burn Protocol TB 9 Chemical and Electrical Burn Protocol TB 2 ***if indicated***
	Pain Control Protocol UP 11 ***as indicated***

Age Specific Blood Pressure
indicating possible shock

Age 0 – 28 days: SBP < 60
Ages ≥ 1 month: SBP < 70
Age 1 – 9: SBP < 70 + (2*x* Age)

Ages 10 – 64: SBP < 90
Ages ≥ 65: SBP < 100

All ages:
Shock Index HR > SBP

P — Consider
Midazolam 2.5 mg IV / IO / IN
5 mg IM
Age ≥ 65: 1mg IV / IO / IN
2.5 mg IM
Pediatric: 0.2 mg / kg IV / IO / IN
Max 2.5 mg IV / IO / IN
Max 5 mg IM
Over 2 – 3 minutes as needed

Entrapped < 2 hours

A — **Normal Saline Infusion**
1 Liter per hour IV / IO
Pediatric:
3 x maintenance fluid rate

Entrapped > 2 hours

A — **Decrease Normal Saline Infusion**
500 mL per hour IV / IO
Pediatric:
Maintenance fluid rate

Abnormal ECG
Peaked T Waves
QRS ≥ 0.12 seconds
QT ≥ 0.46 seconds
Loss of P wave
Or
Hemodynamically Unstable
Or
Asystole / PEA / VF / VT

P — **Calcium Chloride 1 g IV / IO**
or
(Calcium Gluconate 2 g IV / IO)
Pediatric: 20 mg/kg IV / IO
Over 2- 3 minutes

P — **Albuterol Nebulizer**
2.5 – 5 mg
May repeat x 3

Sodium Bicarbonate
50 mEq IV / IO
Pediatric: 1 mEq/kg IV / IO

Exit to
Age Appropriate
Cardiac Arrest
Protocol AC 3 / PC 4
Arrhythmia Protocol(s)
if indicated

Rapid Transport to appropriate destination using
Trauma and Burn:
EMS Triage and Destination Plan

Notify Destination or
Contact Medical Control

Trauma and Burn Protocol Section

Crush Syndrome Trauma

** Refer to Length Based Medication Tape for Medication Doses IF pediatric patients weight is unknown **

Pearls

- **Recommended exam: Mental Status, Musculoskeletal, Neuro**
- **Scene safety is of paramount importance as typical scenes may pose hazards to rescuers. Call for appropriate resources.**
- **Crush Injury is a localized crush injury with systemic signs and symptoms causing muscle breakdown and release of potentially toxic muscle cell components and electrolytes into the circulation.**
- **Crush syndrome typically manifests after 1 – 4 hours of crush injury.**
- **Fluid resuscitation strategy:**
  - **If possible, administer IV / IO fluids prior to release of crushed body part, especially with crush > 1 hour.**
  - **If access to patient and initiation of IV / IO fluids occurs after 2 hours, give 2 liters of IV fluids in adults and 20 mL/kg of IV fluids in pediatrics, and then begin > 2 hour dosing regimen.**
  - **If not able to perform IV / IO fluid resuscitation immediately, place tourniquet on crushed limb until IV / IO fluids can be initiated (even if tourniquet is not being used for hemorrhage control).**
- **Pediatric IV Fluid maintenance rate:**
  - **4 mL for the first 10 kg of weight +**
  - **2 mL for the second 10 kg of weight +**
  - **1 mL for every additional kg in weight after 20 kg**

Example: 28 kg pediatric	
First 10 kg:	4 mL/kg/hr = 40 mL/hr
Second 10 kg:	2 mL/kg/hr = 20 mL/hr
Final 8 Kg:	1 mL/kg//hr = 8 mL/hr
	Total: 68 mL/hr rate

- **Consider all possible causes of shock and treat per appropriate protocol.**
- **Majority of decompensation in pediatrics is airway or respiratory related.**
- **Decreasing heart rate and hypotension occur late in children and are signs of impending cardiac arrest.**
- **Shock may be present with a normal blood pressure initially or even elevated.**
- **Shock often is present with normal vital signs and may develop insidiously. Tachycardia may be the only sign.**
- **Patients may become hypothermic even in warm environments. Maintain warmth.**
- Hyperkalemia from crush syndrome can produce ECG changes described in protocol, but may also be a bizarre, wide complex rhythm. Wide complex rhythms should also be treated using the VF/ Pulseless VT Protocol if indicated (AC 9 VF Pulseless VT Protocol and/ or PC 7 Pediatric VF Pulseless VT Protocol).