Under Pressure: Crush Injuries in Technical Rescue

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What is “technical rescue”?

The application of special skills, knowledge, and equipment to resolve unique and/or complex rescue situations.
Vehicle
Structural Collapse
Car Crash

- 2,000lb. Vehicle
- 60mph
- ~490kN of force
FEMA 329: Field Debris Estimating Guide

- ~1,000-2,000 lbs./cubic yard building material
• Dry topsoil: ~75lbs/cubic foot
• Saturated topsoil: ~110lbs/cubic foot
2 cubic yards = 4,000-6,000 lbs
• Shear wall collapse speed:
• 1 cubic yard of soil: 18kN
Kinematics
3.3kN to break ribs
4kN to break femur
Trench Collapse

• Don’t have to be buried to die!
Trench Collapse

Can self-extricate
Trench Collapse

May self-extricate (with tools)
Self-extrication unlikely
Trench Collapse

Self-extrication impossible
Significant medical concerns
Self-extrication impossible
Urgent medical concerns
Trench Collapse

Self-extrication impossible
Likely fatal
Rhabdomyolysis

- Tissue damage
- Tissue hypoxia
- Reperfusion
Rhabdomyolysis

- Calcium influx
- Tissue Damage
- Fluid (Na+)
- ATP depleted
- Muscle Contractions
- Calcium out (Ca+)

Explanation:
- Calcium influx leads to Tissue Damage.
- Fluid (Na+) leads to ATP depletion.
- ATP depletion leads to Muscle Contractions.
- Muscle Contractions lead to Calcium out (Ca+).

This cycle represents the process of Rhabdomyolysis, where damaged muscle leads to the release of calcium, which in turn depletes ATP, causing muscle contractions.
Rhabdomyolysis

- Potassium (K+)
- Myoglobin
- Phosphate
- Thromboplastin
- Creatine
- Creatine Kinase
Rhabdomyolysis

- Acute tubular necrosis
Rhabdomyolysis
(2-16) General: Crush Injuries

EMT

- ABCs and vital signs every 5 minutes, if practical
- Airway management and appropriate oxygen therapy
- Consider EMS physician response, if available, or early physician consultation for prolonged entrapment

EMT STOP

ADVANCED

- Vascular access, ideally at 2 sites (no more than one IO)
- Normal saline 1 liter IV bolus
- Refer to the “General: Pain Management” protocol, as indicated

ADVANCED STOP

CC

- Cardiac monitor, if possible, with 12-lead ECG repeated at 30 minute intervals

CC STOP

PARAMEDIC

- If one complete extremity is crushed > 2 hours, or 2 extremities are crushed >1 hour:
  - Sodium bicarbonate 50 mEq IV slow push every 30 minutes
  - In addition, one minute prior to extrication: Sodium bicarbonate 50 mEq IV

PARAMEDIC STOP

MEDICAL CONTROL CONSIDERATIONS

- If hyperkalemia is suspected and ECG changes, calcium chloride 1 gram IV (over 5 minutes). Repeat in 10 minutes, if there is no resolution of the ECG changes of hyperkalemia
- Albuterol via nebulizer
- Consider application of a tourniquet for prolonged entrapment placed as close as possible to the crush injury prior to the release of the extremity

Key Points/Considerations

- Consider EMS physician response to the scene, if prolonged extrication is anticipated
- A minimum of 50 mL of normal saline should be given between the bolus of calcium chloride and the bolus of sodium bicarbonate
- Hyperkalemia is indicated by PVCs, peaked T-waves, or widened QRS complexes
- After extrication, immobilize the extremity and apply cold therapy; do not elevate the extremity
FENTANYL CITRATE
Inj., USP
(50 mcg/mL)
100 mcg Fentanyl/2 mL (0.05 mg/mL)
WARNING: MAY BE HABIT FORMING.
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