

# Protocol 4-4

**SECTION:** Adult Trauma Emergencies

**PROTOCOL TITLE:** Injury – Crush Syndrome

**REVISED:** 06/2017

**OVERVIEW:**

Crush injuries can result from a variety of mechanisms including mine cave-ins, trench collapses, building collapse, vehicular collisions or industrial accidents. Also called traumatic rhabdomyolysis, it is defined as the prolonged compression, usually 4 - 6 hours but possibly less than 1 hour, of large muscle mass and compromised local circulation. Crush syndrome may also be exacerbated by hypovolemia secondary to hemorrhage. Compression on the body causes a disruption in tissue perfusion to a muscle group leading to cellular hypoperfusion and hypoxia. Cellular perfusion is further decreased due to hemorrhage from torn or compressed vessels. Once the compressive force is relieved, blood flow resumes, releasing the toxic substances that have been collecting in the compressed areas into the systemic circulation. This can result in systemic metabolic acidosis, widespread vasodilation, and hyperkalemia. Metabolic acidosis and high potassium levels could have deleterious effects on the myocardium and lead to patient death. Cardiac arrest due to hyperkalemia typically occurs within the first hour of removal from compression. Because of this, treatment for crush injuries begins prior to patient removal from compression.

# CRUSH INJURIES

HPI	Signs and Symptoms	Considerations
<ul style="list-style-type: none"> <li>• Entrapment of one or more extremities and/or trunk</li> <li>• Time entrapped</li> <li>• Medical history</li> <li>• Allergies</li> <li>• Heart Failure</li> </ul>	<ul style="list-style-type: none"> <li>• Obvious crushing of a muscle mass (arm, leg, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• Extremity fracture</li> <li>• Paralysis, Spinal cord injury</li> <li>• Compartment syndrome</li> </ul>

	EMR	EMT	A	I	P
1. Perform general patient management.	•	•	•	•	•
2. Support life-threatening problems.	•	•	•	•	•
3. Administer oxygen to maintain a <u>SPO<sub>2</sub></u> between 94 - 99%. Support respirations as necessary with a BVM.	•	•	•	•	•
4. Consider activation of local and / or regional technical rescue team.	•	•	•	•	•
5. Start an IV of normal saline and administer normal saline 20 cc / kg bolus, prior to extrication if possible. Maintain perfusion by following the <i>Medical – Hypotension/Shock</i> protocol. <b>DO NOT USE LACTATED RINGERS.</b>			•	•	•
6. Apply BUT DO NOT TIGHTEN <i>tourniquet</i> on entrapped extremity <b>BEFORE</b> extrication. Tighten <i>only</i> if major hemorrhage occurs with extrication.		•	•	•	•

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## CRUSH INJURIES

	EMR	EMT	A	I	P
7. Attach ECG monitor. Obtain / interpret <u>12 Lead ECG</u> . Carefully monitor for dysrhythmias before, immediately after release of pressure and during transport (i.e., peaked T waves, wide QRS, lengthening QT interval, loss of P wave). Contact Medical Control if hyperkalemia is suspected.**				•	•
8. Transport as soon as possible.		•	•	•	•
9. For pain control, consider analgesics					
a. <u>FENTANYL</u> 1 mcg / kg IV / IM, not to exceed 100 mcg single dose. Repeat dose in 10 minutes if necessary. Max total dose is 200 mcg.					
b. If Fentanyl is unavailable, give <u>MORPHINE</u> 0.1 mg / kg IV at 1 mg / min, not to exceed 5 mg single dose with max total dose of 20 mg. If no IV established, administer <u>MORPHINE</u> 0.1 mg / kg IM, not to exceed 10 mg (1.0 mL); repeat IM dose in 10 minutes if necessary.			•	•	•
10. Consider the following options:					
a. Continued boluses of normal saline.			•	•	•
b. For significant crush injuries, administer <u>SODIUM BICARBONATE</u> 1 mEq / kg IV bolus over 2 minutes. Consider administration of bicarb containing IV solution (One liter of D <sub>5</sub> W with 2 amps bicarb infused at 150 cc / hour).				•	•
c. If ECG suggestive of hyperkalemia,** consider <u>ALBUTEROL</u> 5.0 mg via small volume nebulizer.				•	•
d. If ECG suggestive of hyperkalemia, consider <u>CALCIUM CHLORIDE</u> 8 mg / kg of 10% solution IV over 5 minutes.				•	•
11. Transport and perform ongoing assessment as indicated.		•	•	•	•

**PEARLS:**

1. A patient with a crush injury may initially present with very few signs and symptoms. A high index of suspicion should be maintained for any patient with a compressive mechanism of injury.
2. Elevated potassium levels have an increased risk of affecting the myocardium resulting in ventricular tachycardia and ventricular fibrillation.
3. Suspect hyperkalemia if T-waves become peaked, QRS becomes prolonged (> 0.12 seconds), absent P wave, or prolonged QTc\*\*.
4. If a possible field amputation is anticipated, contact Medical Control for guidance.
5. Sodium Bicarbonate will keep the urine alkalotic and assist in preventing acute renal failure.

**\*\*Suggestive signs of Hyperkalemia:**

- Peaked T waves in V1 and V2
- Widened QRS (> 0.12 seconds)
  - QTc > 500

*If any of these findings are noted on a 12 lead: Contact Medical Control*

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