

H02: Crush Injuries

Tom Zajac

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Introduction

Crush injuries result from the entrapment of body parts by compressive forces, resulting in physical trauma and ischemia to tissues. These injuries are most commonly discussed in the context of collapsed structures, though crush injuries can occur even from a patient's own body weight.

If significant muscle mass is involved, crush syndrome can develop following the release of the compression; this is a potentially life-threatening, systemic condition. The major factors that lead to the development of crush syndrome include the degree of compressive force, the amount of muscle mass involved, and the duration of the compression.

The onset of crush syndrome occurs following the reperfusion of the injured muscle upon release. This may have both acute and delayed-onset clinical effects. The three main acute concerns are electrolyte imbalances, which may result in cardiac dysrhythmias (predominantly hyperkalemia), hypovolemia, and metabolic acidosis, all of which can cause shock. The delayed-onset effects include renal failure, acute respiratory distress syndrome, coagulopathies, and severe sepsis.

Delayed medical care or inappropriate rescue management, such as the uncontrolled and rapid removal of the compressive force prior to intervention, may result in rapid clinical deterioration and death of the patient.

Essentials

- Pre-treatment of crush injury prior to release of forces is essential. Failure to treat can result in death.
- On advice of ClinICall, begin aggressive fluid management (see PCP interventions below).
- Electrolyte and dysrhythmia management should be undertaken as per license level.
- Provide analgesia as appropriate.

Additional Treatment Information

- Paramedics and EMRs/FRs should consider the possibility of other concurrent injuries beyond the crush, particularly hypothermia and other potential causes of shock.
- Crush injuries that occur in industrial settings, or in the context of a structural collapse or other disasters, can come with significant hazards for rescuers. Scene safety is paramount – consider the risks of confined spaces, carbon monoxide, hypoxic environments, or toxic atmospheres.
- Additional out-of-hospital resources should be sought early.

Referral Information

All patients with crush injuries should be conveyed to the closest appropriate trauma receiving hospital as per local trauma destination guidelines or clinical pathway.

General Information

- Triage according to the [Pre-hospital Triage and Transport Guidelines for Adult and Pediatric Major Trauma](#) decision tool, including Physiological Criteria, Anatomical Criteria, Mechanism of Injury Criteria, and Special Considerations

Interventions

First Responder

- Provide supplemental oxygen as required

- → [A07: Oxygen Administration](#)
- Consider hypothermia; protect patient from environment; consider thermal protection, insulation from cold surfaces, and warming blankets as available/appropriate
- Consider application of a tourniquet proximal to the injury site on the extremity, prior to release of the crush force
 - → [PR03: Tourniquets](#)

Emergency Medical Responder – All FR interventions, plus:

- Provide supplemental oxygen to maintain SpO₂ ≥ 94%
 - → [A07: Oxygen Administration](#)
- Coordinate lift with treatments
- [CiniCall consultation recommended](#) prior to tourniquet application and to discuss care planning options.
- Consider waiting until higher licensed paramedic is on scene; prepare for cardiac arrest on release of weight
- Manage pain
 - → [E08: Pain Management](#)

Primary Care Paramedic – All FR and EMR interventions, plus:

- Obtain vascular access where possible
 - → [D03: Vascular Access](#)
- Consider administering normal saline 2 L immediately prior to release of crush force
 - [CiniCall consultation recommended](#) prior to fluid administration and to discuss care planning options.
- Consider continuous [salbutamol](#) therapy
 - [CiniCall consultation required](#) prior to salbutamol administration and to discuss care planning options.

Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- Obtain vascular access where possible
 - → [PR12: Intraosseous Cannulation](#)
 - → [PR13: External Jugular Cannulation](#)
- Correct electrolyte disturbances
 - [Calcium chloride](#)
 - [Sodium bicarbonate](#)
 - [CiniCall consultation required](#) prior to administration of sodium bicarbonate.
 - Caution: sodium bicarbonate and calcium chloride cannot be administered at the same time through the same IV/IO line

Critical Care Paramedic – All FR, EMR, PCP, and ACP interventions, plus:

- Induce paralysis and facilitate ventilation if required; use [rocuronium](#) for paralysis – [succinylcholine is contraindicated in crush syndrome](#)
- Intravenous dextrose and insulin (IFT to tertiary care [on advice of ETP/EPOS](#))
- [Mannitol](#) 20%: may be considered once ongoing urinary production and output has been verified (IFT to tertiary care [on advice of ETP/EPOS](#); [mannitol is contraindicated in anuric states](#))
- Kayexelate – sodium polystyrene sulfonate (when practical and if prolonged ITF transfer to tertiary care is expected [on advice of ETP/EPOS](#))

Evidence Based Practice

General Major Trauma Care

Supportive

- [Acetaminophen IV](#)
- [Fentanyl](#)

- [Morphine](#)
- [Nitrous Oxide](#)
- [NSAIDs](#)
- [ALS](#)
- [Blood Glucose Monitoring](#)
- [ETCO2](#)
- [HEMS](#)
- [Ketorolac \(Toradol\)](#)
- [Mechanical Intraosseous Insertion](#)
- [Optimal Trip Destination](#)
- [Point of Care Lactate](#)
- [Trauma Team Activation](#)
- [Acetaminophen PO](#)

Neutral

- [Ketamine](#)
- [Thermostasis](#)
- [Oxygen](#)
- [IV access](#)
- [Manual Intraosseous Insertion](#)
- [Temperature Monitoring](#)

Against

- [Benzodiazepines](#)

Limb Amputation/Mangled/Major Hemorrhage

Supportive

- [Hemostatic dressing](#)
- [Pre-alert \(massive transfusion protocol\)](#)
- [Tourniquet \(limb\)](#)

Neutral

- [Direct Pressure](#)
- [Tourniquet \(junctional\)](#)

Against

Extremity Trauma

Supportive

- [Antibiotic \(open fracture\)](#)

Neutral

- [Procedural Sedation](#)

Against

References

1. International Search And Rescue Advisory Group. The Medical Management of the Entrapped Patient with Crush Syndrome 2023 [Link](#)

Practice Updates

- 2022-09-28: changed salbutamol to requiring consultation prior to administration

