Joint Trauma System

Damage Control Resuscitation (DCR)

Clinical Practice Guideline (CPG) Training

Joint Trauma System Trauma Care Educational Program

Disclosure/Disclaimer

- No financial disclosures
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Agenda

- Purpose
- Summary
- Background
- Blood Products
- Hemostasis
- Patient selection
- Pre-hospital DCR
- Special Considerations
- Performance Improvement (PI) Monitoring
- References
- List of Appendices in CPG
- Contributors

Purpose

- These slides are based on the JTS Damage Control Resuscitation CPG which provides guidance to minimize variation in resuscitation practices and improve the care of massively hemorrhaging, severely injured casualties.
- Date of CPG publication: 12 Jul 2019
- JTS CPGs are evidence-based guidelines developed by subject matter experts in the military and civilian communities. CPGs are compiled from DoD Trauma Registry data, health data abstracted from patient records and after action reports.
- Information contained in this presentation is only a guideline and not a substitute for clinical judgment.

Summary

- Primary goal is to restore homeostasis and prevent the development of tissue hypoxia, oxygen debt, and coagulopathy.
- The primary goal is accomplished through hemorrhage control and blood transfusion.

Background

- Hemorrhage is the leading cause of preventable death on the battlefield.
- Damage Control Resuscitation (DCR) is an extension of the concept of Damage Control Surgery (DCS).
  - Prioritizes non-surgical interventions that may reduce morbidity and mortality from trauma and hemorrhage.
  - Major principles include restore homeostasis, prevent development of tissue hypoxia, oxygen debt and coagulopathy.
- Key element of fluid optimization is careful documentation of all fluids, interventions, and medications given.

Background

- Efforts focused on:
  - Transfusion of whole blood or its equivalent (mixture of components)
  - Limited use of crystalloids
  - Adjunctive measures to mitigate hemorrhagic shock and coagulopathy to include:
    - Relative hypotensive resuscitation (target SBP 80-90 mm Hg)
    - Compressive/hemostatic dressings and devices
    - Empiric use of Tranexamic Acid (TXA)
    - Prevention of acidosis and hypothermia
    - Expeditious delivery to definitive surgical control

Blood Products

- Those that require a massive blood transfusion have a survival benefit from whole blood or a blood product ratio of 1:1:1.
  - 1 unit of plasma:1 Unit of platelets:1 unit of packed red blood cells (PRBC)
  - Cryoprecipitate can be added to the component mix, when available, to create a 1:1:1:1 ratio.
  - Practice of large amount of crystalloid or PRBCs alone is no longer standard of care.
- One gram of calcium IV/IO should be given to patients in hemorrhagic shock during or immediately after transfusion of the first unit of blood product and with ongoing resuscitation after every 4 units of blood products.
  - Monitor ionized calcium.
  - Calcium should be given for ionized calcium less than 1.2mmol/L.

Red Blood Cells

Red Blood Cells

- Can be stored for up to 42 days with additive solution (AS-5).
- Can be frozen with glycerol cryoprotectant for up to 10 years.
  - 4 hours to thaw
  - Must remove lethal glycerol before transfusion.
  - Can be stored for 14 days with refrigeration after deglycerolizing and thawing.

Plasma

Plasma

- Can be stored and thawed on demand with a 30-minute delay for thawing.
- Thawed plasma can be stored for 5 days.
- Liquid and freeze-dried plasma may be encountered and can be used interchangeably.
- Both blood group AB and A can be considered universal donors.

Platelets

Platelets

- Traditionally stored at room temperature with constant agitation for 5-7 days
- Cold-stored platelets (CSP) without agitation can be stored up to 3 days (reduces risk of bacterial growth)
- Cold-stored platelets in platelet additive solution (CSP-PAS) can retain function for 15 days
- Traditionally, CSP, and CSP-PAS can be collected and used interchangeably

Whole Blood

Whole blood

- Generally used due to logistical constraints.
- Collected from “walking blood banks” and are not prospectively tested for transfusion-transmitted diseases (TTDs).
  - Recipients must be tested at 3, 6, and 12 months post transfusion.
  - Blood must be an ABO match and pre-identifying low anti-A, and anti-B titer type O donors ideal.
- “O low titer” donors can be pre-tested for TTDs, confirmatory typing and antibody screen.
  - Low titer Group O whole blood (LTOWB), can be stored or refrigerated for 21 days in CPD or 35 days in CPDA-1.

Hemostasis

- Mechanical hemorrhage control
  - Tourniquets for extremity injury
  - Hemostatic dressings (Combat or Celox Gauze) for superficial wounds
  - Junctional tourniquets for junctional (axillary, neck, and groin) hemorrhage
  - Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for truncal hemorrhage
- Pharmacologic Adjuncts
  - TXA only agent found to reduce mortality if given within 3 hours of injury.
  - Prothrombin complex concentrates (PCCs) only indicated for rapid warfarin reversal rFVII no longer recommended.

Patient Selection (1)

- Patients receiving uncrossmatched Type O blood in the emergency department and later a massive transfusion have increased risk of morbidity and mortality due to exsanguination.
  - Massive transfusion (MT) defined as receiving 10 or more PRBC units within 24 hours post injury.
  - Rapid identification and hemostasis established at the earliest level of care possible.
- Predictive factors for MT support in trauma 3 or more factors indicate 70%+ risk for MT:
  - Systolic blood pressure < 110 mm Hg
  - Heart rate > 105 bpm
  - Hematocrit < 32%
  - pH<7.25

Patient Selection (2)

- Other risk factors associated with MT or need for aggressive resuscitation:
  - Injury pattern (above-the knee traumatic leg amputation, multi-amputation, penetrating injury to chest or abdomen)
  - > 2 regions positive on FAST scan
  - Lactate concentration of admission >2.5
  - Admission INR ≥ 1.2-1.4
  - Near Infrared Spectroscopy (NIR)-derived StO2<75%
  - Base Deficit (BD) > 6 mEq/L

Patient Selection (3)

- Recognition of clinical patterns with the need for MT essential for effective triage.
- Critical to communicate with blood bank when a patient requiring MT identified.
- Laboratory evaluation with thromboelastography or rotational thromboelastometry (ROTEM) can be helpful in identifying patients that may require MT.
  - May not be available.
  - PT and INR are unreliable in clinical conditions characterized by loss of fibrinogen/trauma patients.

Pre-hospital DCR (i)

Order of priority for fluid administration:

- Whole blood (fully TTD tested group O low titer preferred)
- Blood components at a 1:1:1 ratio, with cryoprecipitate when available
- PRBCs plus plasma at 1:1 ratio
- Plasma with or without PRBCs
- PRBCs alone

Pre-hospital DCR (2)

- During periods of prolonged evacuations and no blood products, crystalloid and non-blood colloid may be required for those at risk of imminent death.
  - Albumin (5% or 25%) is best of options
  - Supplement albumin with fibrinogen concentrate and TXA if available
  - Hextend or Hespan should be avoided
  - Hypertonic saline is only used for treatment of raised intracranial pressure

Pre-hospital DCR (3)

- Blood products can be limited.
  - "Golden Hour Boxes" or similar isothermal transport devices containing blood components on patient transport vehicles.
  - Blood products should ideally be warmed to 37°C.
- Maintain a target Systolic Blood Pressure (SBP) for DCR at 100 mmHg (100-110mmHg if TBI is presumed) when resuscitating with blood products.
- Compressive/hemostatic dressings, devices and pharmacologic hemorrhage control options should be utilized as appropriate.
- Aggressive prevention of acidosis and hypothermia with rapid delivery of the patient to definitive surgical control.

Special Considerations

- Children under a weight of 30 kg should receive transfusions of PRBC, FFP, or apheresis platelets in “units” of 10-15 mL/kg
  - Trauma packs may contain 3000-4000 mL of intravascular volume when a child may have a total volume of 1800-2400 mL
  - MT defined as ≥40 mL/kg of blood products in 24 hours
- Over-resuscitation contributes to morbidity and mortality
- Administer 2gm TXA bolus as close to the time of injury as possible and not outside of the 3 hours window. Follow by 1gm infusion over 8 hours.
- Prolonged CPR > 20-30 minutes futile in children with cardiac arrest with trauma related injuries

PI Monitoring

- Population of Interest
  - All patients who receive blood product transfusion within 3 hours of injury.
  - All patients with severe traumatic injury (ISS ≥16 and ≥ 2 body regions injured with AIS severity ≥ 2 AND SBP < 100 OR HR > 100 OR hematocrit < 32% OR pH <7.25 within 3 hours of injury)
  - Massive transfusion includes all patients who received 10 or more units of RBC + WB within first 24 hours.
- Intent (Expected Outcomes)
  - All patients in the population of interest receive TXA within 3 hours after injury.
  - All patients in the population of interest who receive 1 or more units of blood product also receive calcium.
  - All MT patients receive transfusion of plasma:RBC in a ratio between 0.5:1 to 1:1.5.
  - All MT patients receive platelet or WB transfusion.
  - All MT patients receive cryoprecipitate or WB.
  - For the population of interest, the first resuscitation fluid given after injury is a blood product, ideally cold-stored LTOWB.

PI Monitoring

- Performance/Adherence Metrics
  - Number and percentage of patients in the population of interest who receive TXA within 3 hours after injury (or documented ROTEM indicating no fibrinolysis).
  - Number and percentage of patients in the population of interest receiving 1 or more units of blood product who also receive calcium.
  - Number and percentage of MT patients who receive plasma:RBC in a ratio between 0.5:1 to 1:1.5. (calculate ratio for first 24 hours).
  - Number and percentage of MT patients who receive platelet or WB transfusion.
  - Number and percentage of MT patients who receive cryoprecipitate or WB.
  - Number and percentage of patients in population of interest who received a blood product as the first resuscitation fluid.
  - Number and percentage of patients in population of interest who received cold-stored LTOWB as the first resuscitation fluid.
- Data Source
  - Patient Record
  - Department of Defense Trauma Registry (DoDTR)
  - Theater Medical Data Store

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CPG Appendices

- **Appendix A:** Example of a Massive Transfusion Procedure at an USCENTCOM Level III Facility
- **Appendix B:** Additional Information Regarding Off-label Uses in CPGs

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