INTERNATIONAL TRAUMA LIFE SUPPORT

DAMAGE CONTROL RESUSCITATION AND MANAGEMENT OF SEVERE HEMORRHAGE/SHOCK IN THE PREHOSPITAL SETTING

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The guidelines and references contained in this document are current as of the date of publication and in no way replace physician medical oversight.

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INTRODUCTION

The purpose of this document is to update International Trauma Life Support (ITLS) instructors and providers of the ITLS position regarding the approach to damage control resuscitation and the management of severe hemorrhage /shock in the prehospital setting.

Before proceeding, the reader must understand the following terms as defined in this statement:

- Damage Control
- Damage Control Surgery
- Damage Control Resuscitation
- Remote Damage Control Resuscitation

Damage Control Resuscitation (DCR) gets its name from the Navy term "Damage Control" which is defined as "the capacity of a ship to absorb damage and maintain mission integrity."[1] A simplistic view are those efforts required to stabilize a grave insult to a ship, or in the case of resuscitation, the body. The concept of DCR developed over a progression of temporizing measures that date back to 1902.[2] This culminated with the recommendation of use of the term "Damage Control" in 1993 at the University of Pennsylvania.[3] C. William Schwab, MD, Chief of Trauma at University of Pennsylvania, had done his surgical residency through the Navy at the end of the Vietnam War. He trained with Vietnam combat surgeons and received many critically injured soldiers evacuated from Southeast Asia. He was the one who proposed using the term from his Navy experience. Damage Control Resuscitation was included as a U.S. Department of Defense clinical practice guideline as early as 2004 and has become a standard of care in both military and civilian settings.

DCR principles begin in the pre-surgical arena and usually takes place during critical care transport, by ground or air, and in the emergency department. The goals of care are to establish and maintain appropriate airway and ventilatory management; establish and continue fluid resuscitation, preferably with blood products; and maintain normal body temperature. These combined efforts help to normalize tissue oxygen delivery and prevent or treat acidosis and coagulopathy.

These proven components of care help improve survivability and are now being deployed in the pre-hospital (remote) locations in what is now termed "Remote Damage Control Resuscitation," or RDCR.[4]

The goals of DCR and RDCR are essentially the same. What differs is often the availability of recommended components of care. Intravenous fluid therapy administration achieves euvolemia using a balanced approach. Ventilation management ensures adequate rate and FIO_2, and preservation of body heat and warming measures reduce hypothermia.

BACKGROUND

The pathophysiologic response to severe injury is characterized by the classic "lethal triad" of hypothermia, coagulopathy and acidosis.[5] These form the downward spiral to death if not corrected.

DCR is an organized approach, rather than a specific intervention. Key elements are early blood product administration along with major hemorrhage control to maintain blood volume and physiologic stability.[6]

Large volumes of crystalloid fluid lead to imbalances of intracellular and extracellular osmolarity that disturbs cell volume. This disrupts regulatory mechanisms responsible for controlling the inflammatory cascade.[7]

Tranexamic acid (TXA) has been used for years to help control excessive bleeding from everything from dental surgery to postpartum hemorrhage. The CRASH-2 trial showed noticeable reductions in mortality from excessive bleeding, however the benefits of TXA decrease by approximately 10% for each 15 minute period beyond 3 hours from the time of injury.[8,9]

The goal now is to start this approach in the prehospital setting and continue through definitive care. The principals of RDCR are simple; control external hemorrhage, followed by transfusion of whole blood (WB) or reconstituted WB with components in a 1:1:1 RBC:FFP:PLT transfusion ratio when possible, limit the use of crystalloids to avoid dilutional coagulopathy and

incorporate other adjunctive measures to mitigate hemorrhagic shock and acute traumatic coagulopathy, including:[10]

- Early use of tranexamic acid (TXA)
- Calcium repletion in patients at risk of hypocalcemia (massive transfusion protocol [MTP] causes excess citrate in the system, which binds with ionized calcium)[11]
- Permissive hypotension
- Prevention of acidosis and hypothermia
- Expeditious delivery to a damage control surgical capability (trauma center)

CONSIDERATIONS

The ability to initiate or maintain balanced resuscitation will largely be dependent on the availability of fluids, blood products and capabilities of the EMS system treating the patient. Dried plasma is an option when desired blood products are not available.[12]

In severe head injured patients, a GCS of <8 or spinal injury are generally exceptions to permissive hypotension. In such cases, the recommendation is to maintain a higher blood pressure. The Guidelines for Prehospital Management of Traumatic Brain Injury from the Brain Trauma Foundation, 4th Edition,[15] evaluated the evidence with regard to this threshold depending on age. There was insufficient evidence to support a Level I or II recommendation. A Level III recommendation, however, was made stating that this age-related threshold may be considered to decrease mortality and improve outcomes. It mentions in general, SBP >100 mmHg as a minimum threshold associated with lower mortality promoting cerebral perfusion. It would be appropriate and safe to adopt this as a target blood pressure in the prehospital setting.

PROCEDURE

<u>HEMORRHAGE CONTROL:</u>
DCR complexity is based in large part by the extent and amount of uncontrolled hemorrhage. Priority is still to initiate and maintain bleeding control, use of direct pressure, elevation, tourniquets, hemostatic agent/wound packing (combat gauze, Z-fold), junctional tourniquet, and finally surgical intervention.[13]

<u>FLUIDS & TXA:</u>
Patients who are victims of severe injury and who are likely to require fluids or IV medications should have a minimum 18g IV (ideally 14g) established or IO. If not in shock, hold fluids and reassess often. (Oral fluids may be given as tolerable in remote situations.)

Administer 1 gm of tranexamic acid (TXA) in 100 ml NS/LR via IV over 10 minutes, preferably within 1 hour of injury but not to exceed 3 hours from injury.[10] Afterward, administer a second dose of TXA 1 gm infused over 8 hours (provided that the time from injury has not exceeded 3 hours).[14]

Shock criteria:

- Altered mental status in absence of TBI
- Weak or absent radial pulse

If shock is present, treatment with a 1:1:1 ratio of plasma, RBCs and platelets is ideal.

NOTE: Storage challenges and immediate availability of plasma products may differ. While FFP and thawed plasma are ill suited for RDCR, liquid plasma has fewer constraints and much longer shelf life.

Additional fluid resuscitation should include LR/NS or Plasma-Lyte A in smaller 500 ml boluses and frequent reassessment.

Fluid resuscitation should continue until:

- Return of a palpable radial pulse, **OR**
- Improved mental status, **OR**
- SBP > 90 mmHg.

*NOTE: If altered mental status is due to TBI **AND** there is a weak/absent radial pulse, fluid resuscitation is recommended to maintain a radial pulse SBP> 100 mmHg, MAP>65 mmHg, **OR** a normal radial pulse.*

TREATMENT FOR HYPOCALCEMIA:

Current recommendation to maintain a concentration of at least 0.9 mmol/L and continue to treat for hypocalcemia after massive transfusion is ongoing.[11]

PERMISSIVE HYPOTENSION:

The administration of large volumes of crystalloid solutions is shown to create imbalances of intracellular osmolarity which negatively affect cell volume and are associated with cardiac and pulmonary complications.

Restricted fluid resuscitation is indicated if blood products are not available and should be limited to smaller 500 ml boluses with frequent reassessment to maintain either a palpable radial pulse, improved mental status or SBP> 90 mmHg.[5]

*NOTE: If altered mental status is due to TBI **AND** there is a weak/absent radial pulse, fluid resuscitation is recommended to maintain a radial pulse SBP> 100 mmHg, MAP>65 mmHg, **OR** a normal radial pulse.*

PREVENTION OF ACIDOSIS AND HYPOTHERMIA:

Reversal of metabolic acidosis through drug therapy has not been shown to be beneficial and does not reverse coagulopathy. Instead the recommendation is to control acidosis though fluid and blood resuscitation.

Rewarming is critical and active and passive rewarming using warm blankets, removal of wet clothing and initial use of warm fluids is ideal. Warm fluids at a temperature of 40-42℃ with efforts made to reduce additional heat loss.

EXPEDITIOUS TRANSPORT TO TRAUMA CENTER:

As previously stated in this article, DCR is what allows the victim to survive until Damage Control Surgery. Transportation should not be delayed to the closest appropriate trauma resources to provide surgical control of ongoing hemorrhage and continuing DCR.[14]

MEDICAL OVERSIGHT

Medical oversight should continue to review current literature and develop proper prehospital EMS protocols in regard to appropriate use of TXA, blood products and fluid restriction. Implementation of this protocol should be monitored and supervised through a quality assurance program.

CONCLUSION

It is the position of ITLS that there is strong evidence to support the use of a coordinated DCR approach to the management of severely injured patients and that remote (prehospital) providers, medical directors and receiving facilities coordinate their efforts to provide for the initiation of care and follow-up care needed to drive survivability.

It is the position of ITLS that there is sufficient evidence to support the routine use of TXA in the prehospital environment.

It is the position of ITLS that there is sufficient evidence to support expanding the use of blood products into the prehospital environment as both the storage technology allows and EMS oversight gains acceptance.

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Current Thinking

Damage Control Resuscitation and Management of Severe Hemorrhage/Shock in the Prehospital Setting

International Trauma Life Support

The guidelines and references contained in this document are current as of the date of publication and in no way replace physician medical oversight.

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ABSTRACT

This is the current thinking of International Trauma Life Support (ITLS) with regard to the approach to damage control resuscitation and the management of severe hemorrhage /shock in the prehospital setting.

CURRENT THINKING

It is the position of International Trauma Life Support that:

1. There is sufficient evidence to support an organized Damage Control Resuscitation protocol for severely injured patients which should also address the administration of TXA and subsequent infusion to prevent partial or incomplete treatment.

2. There is sufficient evidence to support the early and routine use of blood products in the prehospital environment based on both the 2014 TXA position statement and no new negative studies.

3. There is sufficient evidence to support expanding the use of blood product into the prehospital environment as both the storage technology allows and EMS oversight gains acceptance.

4. ITLS makes these recommendations knowing that three large studies are taking place and the committee will review the results and modify this document as indicated.