Remote Damage Control Resuscitation (Updated 16-01-20)

Signs and Symptoms*:

1. Hemorrhage is the leading cause of preventable death on the battlefield.

2. Damage Control Resuscitation (DCR) emerged as an extension of a principle used by trauma surgeons called Damage Control Surgery (DCS), which limits surgical interventions to those which address life-threatening injuries and delays all other surgical care until metabolic and physiologic derangements have been treated. Recognizing that this approach saved lives, DCR was developed to work synergistically with DCS and prioritize non-surgical interventions that may reduce morbidity and mortality from trauma and hemorrhage.

3. The severity of hemorrhagic shock can be graded based on the scale of derangement in vital signs, such as heart rate and blood pressure, and by the presence and severity of clinical signs and symptoms such as pallor, tachypnea, and a reduced level of consciousness. In patients with injury patterns that are at a higher risk for internal bleeding (e.g. penetrating injury, blunt force trauma, falls etc.) and/or for those exhibiting symptoms of decompensation without any external signs of uncontrolled hemorrhage, internal bleeding should be suspected.

4. The major principle of DCR is to restore homeostasis and prevent or mitigate the development of tissue hypoxia and oxygen debt as well as coagulopathy. This is accomplished through aggressive hemorrhage control and blood transfusion, which restores tissue oxygenation and not only avoids platelet and coagulation factor dilution, but also replaces lost hemostatic potential. Complimentary staples of DCR include the empiric use of Tranexamic Acid, prevention of hypothermia and expeditious delivery to definitive surgical control.

Contraindications:

1. Allergy to an indicated medication.
2. Administration of Tranexamic Acid is contraindicated if >3hr has passed since initial injury.

Management:

1. Execute appropriate casualty assessment and treatment as per Figure 1 – *Remote Damage Control Resuscitation Flowchart*.
2. Determine likelihood for Massive Blood Transfusion as per Figure 2 – *Indications for Massive Blood Transfusion.*
3. Treat pain per the *SOMT Pain Protocol.*
4. Treat open wounds with obvious surface contamination per the *SOMT Antibiotic Trauma Protocol*.

Disposition:

1. Acute trauma patients require priority evacuation.

* Adapted from the *JTS Damage Control Resuscitation Guideline - Feb 2017*

Figure 1 – Remote Damage Control Resuscitation Flowchart

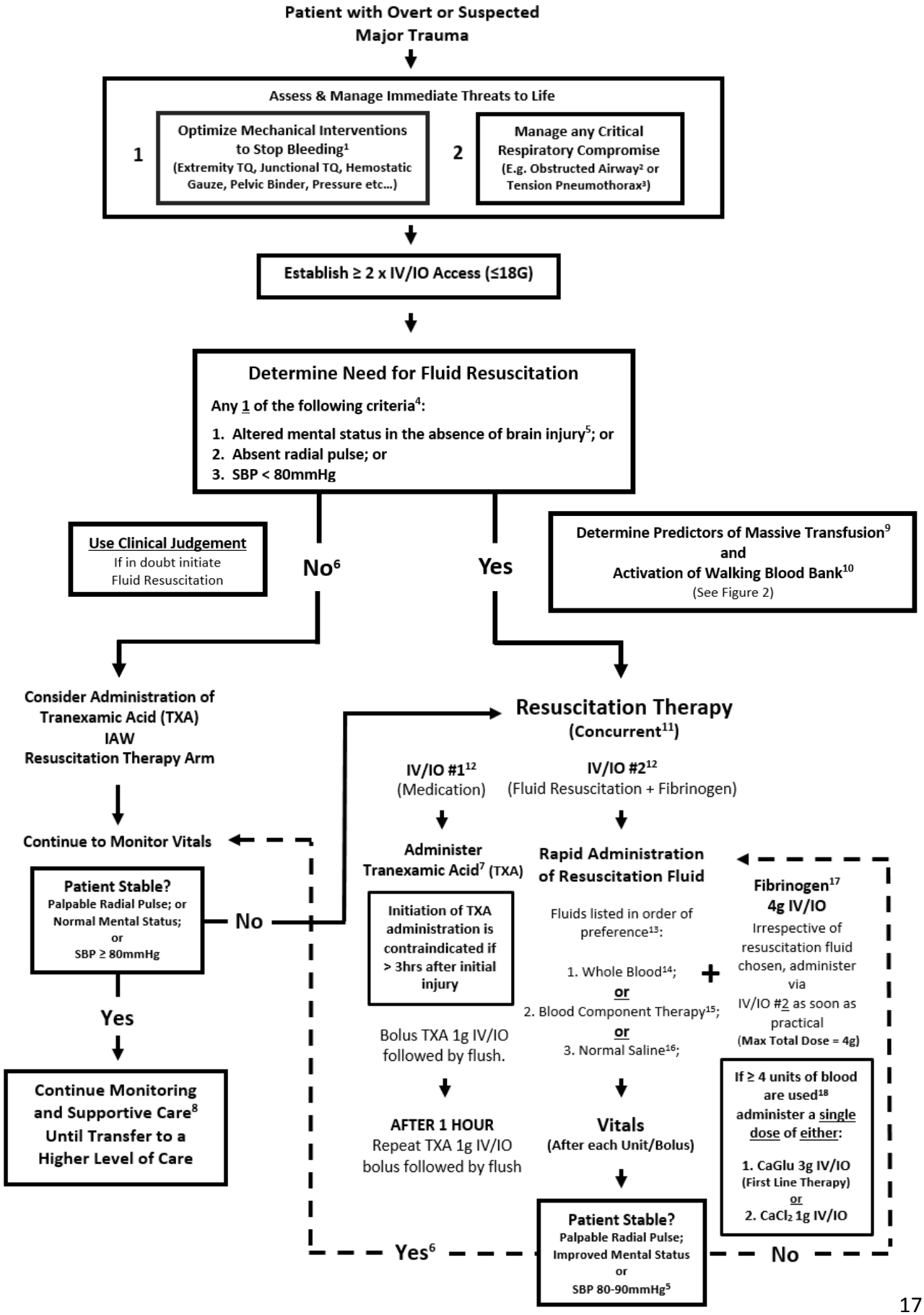
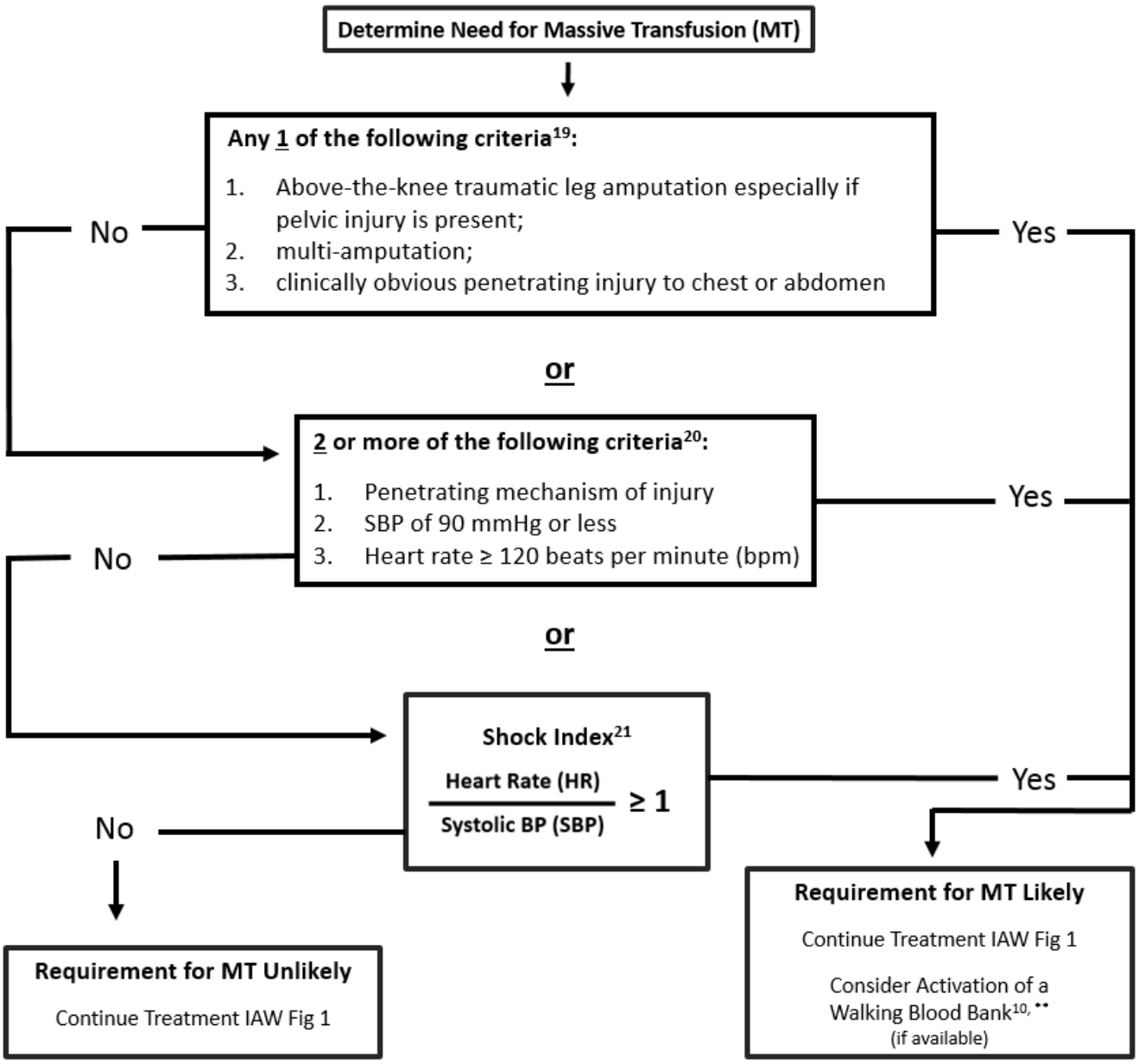


Figure 2 – Predictors of Massive Blood Transfusion[4]



** If adequate quantities of stored blood products are unavailable, a Walking Blood Bank[10] should be immediately activated if the capability exists.

Notes:

1. Optimize mechanical interventions IAW *US TCCC Guidelines – Aug 2018*, as well as, *CAF Med Tech Protocols – 2014 3.1 External Hemorrhage* and *3.2 Tourniquet Assessment and Removal*.
2. Manage airway IAW *Med Tech Respiratory Protocol 2.1 – Airway Algorithm (CAF Med Tech Protocols – 2014)*.
3. Manage tension pneumothorax IAW *SOMT Chest Tube Protocol (SOMT Protocols – Mar 2016)*.
4. Fluid resuscitation criteria based on *US TCCC Guidelines – Aug 2018.*
5. Hypotensive resuscitation should not be utilized for patients with CNS injury because of associated adverse outcomes in this population. In general, patients with CNS injury benefit from avoidance of even transient hypotension and hypoxia (*JTS Damage Control Resuscitation Guideline - Feb 2017*). If a casualty with an altered mental status due to suspected TBI has a weak or absent radial pulse, resuscitate as necessary to restore and maintain a normal radial pulse. If BP monitoring is available, maintain a target systolic BP of at least 90 mmHg (*US TCCC Guidelines – Aug 2018*).
6. Although Assessment algorithms are useful tools, practitioners are reminded to rely on their clinical judgement when deciding whether or not to initiate or halt fluid resuscitation therapy.
7. Administer the initial dose of Tranexamic Acid (TXA) as soon as practical after injury in trauma pts with clinical evidence of significant hemorrhage or those who are considered to be at risk for significant hemorrhage. **If more than 3 hours has elapsed since injury do <u>not</u> administer as evidence suggests an increased chance of death compared to placebo** *(Roberts, I. et al. The CRASH-2 trial: a randomised controlled trial and economic evaluation of the effects of tranexamic acid on death, vascular occlusive events and transfusion requirement in bleeding trauma patients. Health Technol Assess 2013; 17(10))*.
8. In addition to the dedicated monitoring of vitals, management of pain, and optimization of mechanical interventions to stop blood loss, clinicians should be cognizant of the risk of hypothermia. Hypothermia can occur due to blood loss and hypoperfusion even when ambient temperatures are elevated. Treatment should include urgent, active re-warming with all available means including heated fluids, blankets, warm environments, and rapid surgical care to minimize blood and heat loss. (Adapted from the *JTS Damage Control Resuscitation Guideline - Feb 2017)*.
9. Massive Transfusion (MT) is defined as the requirement for 3+ units of blood in 1hr or 10+ units in 24hrs. (*UpToDate Guideline - Initial Mgmt of Moderate to Severe Hemorrhage in the Adult Trauma Patient – Oct 2018*).
10. A Walking Blood Bank shall be activated IAW DHSO SOP *"Whole Blood in the Operational Environment".*
11. Ideally, resuscitation fluid, TXA and fibrinogen would all be administered immediately and concurrently.
12. In the event that only one IV/IO access is obtainable, priority should be given to administering blood products first followed by TXA. N**either TXA nor calcium salts should be directly mixed with blood products during or in advance of transfusion.** Therefore, if these therapies are being administered using the same IV/IO line, ensure the line is appropriately flushed prior to administering.
13. Preferred order adapted from *JTS Damage Control Resuscitation Guideline - Feb 2017, US TCCC Guidelines – Aug 2018*, as well as, *UpToDate Guideline - Initial Mgmt of Moderate to Severe Hemorrhage in the Adult Trauma Patient – Oct 2018*.
14. Whole Blood (WB) is the preferred fluid for RDCR. Choice between Warm Whole Blood (WWB) and Cold Whole Blood (CWB) should be based on whichever fluid is most readily available. Irrespective of source, WB should ideally be delivered using a fluid warmer (*US TCCC Guidelines – Aug 2018*).
15. Blood products, listed in order of preference, include: (1) plasma, red blood cells (RBCs) and platelets in a 1:1:1 ratio; (2) plasma and RBCs in a 1:1 ratio; and (3) plasma or RBCs alone (*US TCCC Guidelines – Aug 2018*). (Note: 1 Unit Fresh Frozen Plasma (FFP) = 1 Unit Freeze Dried Plasma (FDP)).
16. Reassess the casualty after each 250 - 500 ml IV bolus. Note that infusion of 1.5 liters or more of crystalloid fluid has been associated with increased mortality *(Ley, EJ et al. Emergency Department Crystalloid Resuscitation of 1.5 L or More is Associated with Increased Mortality in Elderly and Nonelderly Trauma Patient. J Trauma. 2011;70: 398–400)*.
17. While there is presently limited evidence supporting the use of fibrinogen concentrate in trauma, smaller trials have suggested safety and potential benefit with respect to relative rates of hemorrhage, shock, multi-organ failure and the requirement for massive transfusion *(MILITARY MEDICINE, 183, 1/2:e45, 2018 - Fibrinogen*

Concentrate in the Special Operations Forces Environment). The JTS *Damage Control Resuscitation Guideline – Feb 2017* makes similar acknowledgements citing that fibrinogen is the fundamental substrate of clot formation and that it is rapidly consumed in trauma. **Fibrinogen concentrate products should not be premixed with other medicinal products or intravenous admixtures in advance of administration.**

18. Citrate is a preservative used in blood and some blood product preparations. It chelates free plasma calcium and, during massive transfusion, can precipitate hypocalcemia. Calcium (First Line - 30ml of 10%† calcium gluconate (CaGlu) or Second Line 10ml of 10%† calcium chloride ($CaCl_2$)) should be given to patients in shock after approximately 4 units of citrated blood products have been transfused *(JTS Damage Control Resuscitation Guideline – Feb 2017)*.

    Sample Dosing Calculation

    Volume of 10% CaGlu required in order to administer 3g:

    a. Convert % Concentration to mg/ml

        † - Units for % concentration = g/ml.

        10% of 1g = 100mg = **100mg/ml soln**.

    b. Calculate # ml required to obtain 3g

        3g = 3000mg.

        # ml of 10% CaGlu required to obtain 3g = 3000mg ÷ 100mg/ml = **30ml**

        30 ml of a 10% CaGlu is required in order to administer 3g CaGlu (= 3 x 10% CaGlu 10ml vials or amps)

19. Injury pattern criteria adapted from *JTS Damage Resuscitation Guideline – Feb 2017.* JTS identifies positive Focused Assessment with Sonography for Trauma (FAST) scan results as diagnostic for MT, however, FAST is not included in Table 2 because its execution is not included in the SOMT scope of practice.
20. Adapted from the Assessment of Blood Consumption (ABC) score. Each positive parameter receives a score of one. Criteria are validated with a score of 2 or more predicting the need for massive transfusion (10+ Units in 24hrs) with a sensitivity of 75 percent and a specificity of 86 percent. *(UpToDate Guideline - Initial Mgmt of Moderate to Severe Hemorrhage in the Adult Trauma Patient – Oct 2018).* FAST scan results can contribute to the ABC score, however, this parameter is not included in Table 2 because execution of FAST is not in the SOMT scope of practice.
21. Shock Index (SI) = Heart Rate (HR) ÷ Systolic Blood Pressure (SBP). Prehospital SI > 0.9 identifies patients at risk for massive transfusion (MT) who would otherwise be considered relatively normotensive under current prehospital triage protocols. The risk for MT rises substantially with elevation of SI above this level. *(Vandromme MJ, Griffin RL, Kerby JD, et al. Identifying risk for massive transfusion in the relatively normotensive patient: utility of the prehospital shock index. J Trauma 2011;70(2):384–8 [discussion: 388–90].).*