

Do More Than Hold Pressure: the Interventional Radiologist's Guide to Hemorrhagic Shock

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Introduction

As the role of Interventional Radiology (IR) in the treatment and management of trauma grows, IR physicians need to be increasingly familiar with the management of hemorrhage. This necessity is reflected in critical care training requirements of the integrated IR/DR resident curriculum. Having a fundamental knowledge of the progression of hemorrhagic shock, blood/transfusion products, and mass transfusion protocols is essential for the interventional radiologist.

Overview

Shock is a state of inadequate perfusion to the peripheral extremities and visceral structures. Hypovolemic shock occurs when there is a decrease in circulating volume, to the point of cardiovascular compromise. Hemorrhagic shock is a subtype of hypovolemic shock, in which circulating blood volume cannot meet tissue Oxygen demands. Common etiologies include trauma, gastrointestinal bleeds, surgery, and iatrogenic causes. Management revolves around resuscitation, with fluids and blood products, and identification of the bleeding source.

Damage Control Resuscitation (DCR)

- DCR is an approach to managing trauma, starting within the ED and continuing to the ICU
- DCR involves hemostatic resuscitation, permissive hypotension if clinically indicated, and damage control surgery. Hemostatic resuscitation is accomplished by balanced blood product transfusions with/without TXA.
- MTP must be initiated early, with preferential use of blood products, and limitation of crystalloid usage
- Damage control surgery is to prevent the lethal triad (coagulopathy, hypothermia, and acidosis) by controlling sources of bleeding and stabilizing vitals, with the aim to transfer to the ICU for replacement of blood products/coagulation factors as soon as possible.

Landmark Studies

Damage Control Resuscitation

Morrison et al	<ul style="list-style-type: none"> •Hypotensive resuscitation results in a significant reduction in blood product transfusions and overall IV fluid administration. •Target minimum MAP of 50 mm Hg, rather than 65 mm Hg, significantly decreases postoperative coagulopathy and lowers the risk of early postoperative death and coagulopathy. 	Hypotensive resuscitation is a safe and accepted strategy among patients in hemorrhagic shock.
Cotton et al	<ul style="list-style-type: none"> •In patients undergoing Damage Control Laparotomy, implementation of Damage Control Resuscitation reduces crystalloid, blood product administration, and decreased mortality. 	

Massive Transfusion

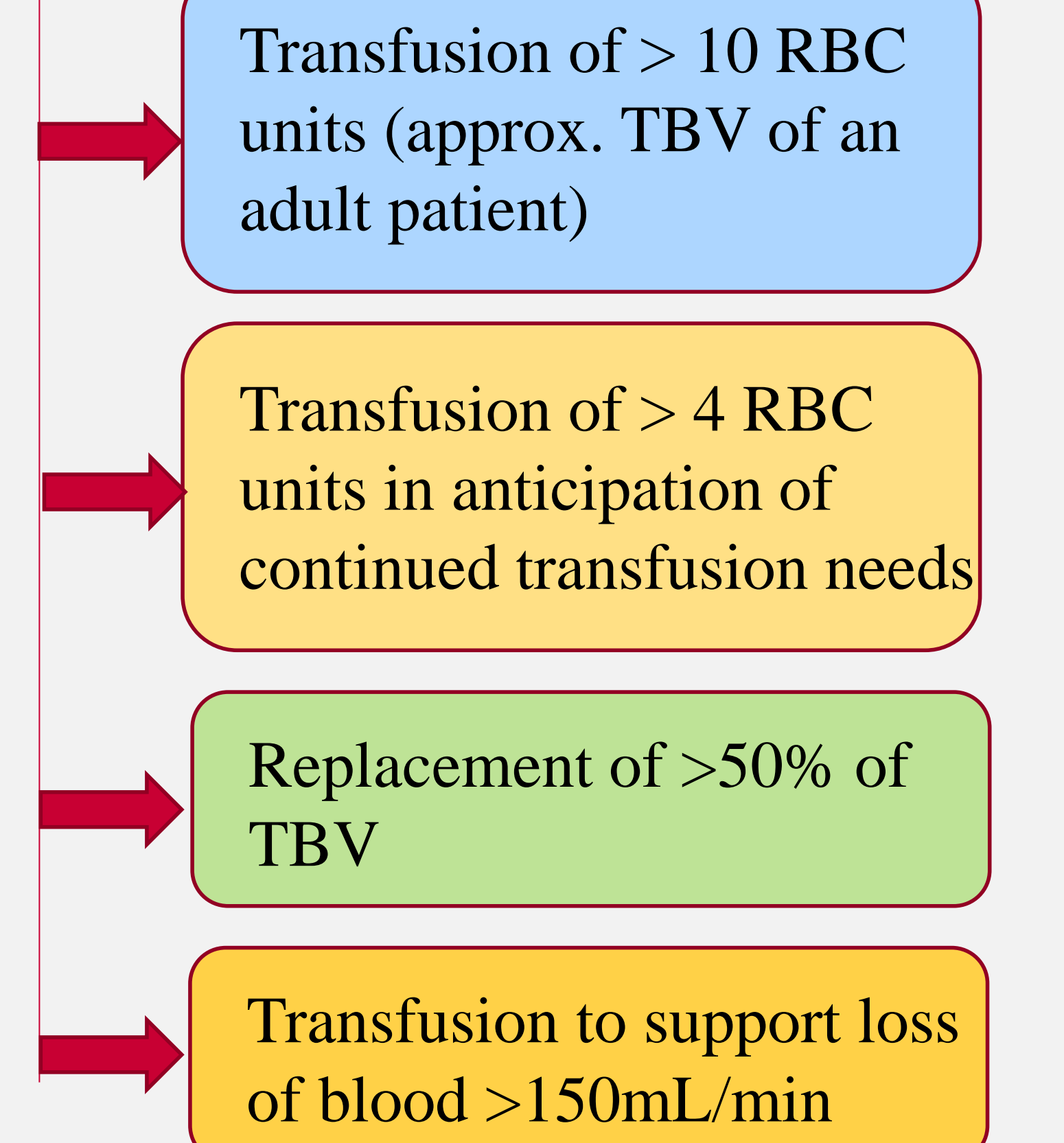
PROPPR	<ul style="list-style-type: none"> •Among trauma patients in hemorrhagic shock, administration of Plasma, Platelets, and Red Blood Cells in a 1:1:1 ratio vs 1:1:2 ratio did not result in significant differences in mortality at 24 hours or 30 days. •More patients in the 1:1:1 group achieved hemostasis and fewer experienced death due to exsanguination at 24 hours. 	Plasma : Platelets : pRBCs in 1:1:1 ratio preferred among trauma patients in hemorrhagic shock.
PROMMTT	<ul style="list-style-type: none"> •Higher plasma and platelet ratios early in resuscitation were associated with decreased mortality in patients who received transfusions of at least 3 units of blood products during the first 24 hours after admission. 	Leading with Plasma and Platelets early, then with RBCs is a guiding principle.
CRASH-2	<ul style="list-style-type: none"> •Tranexamic acid improves survival when administered early in trauma with known or suspected significant hemorrhage. 	TXA is conditionally recommended as a hemostatic adjunct in the early management of severely injured adult trauma patients.
MATTERs	<ul style="list-style-type: none"> •Administration of tranexamic acid in conjunction with blood products for resuscitation following combat injury show improvement in mortality and coagulopathy. 	

Interventional Radiology

- Balloon occlusion, stenting, or embolization is the initial treatment of select visceral arterial injury (i.e. REBOA)
- The SIR published a position statement regarding the role of IR for endovascular management in trauma. Several of the recommendations are:
 - CE CT should be performed if possible, for pelvic trauma. If unstable -> OR
 - EVAR should be performed for grade 3/4 injuries, with non-operative management (antihypertensive, antiimpulsive medications, vitals and imaging follow-up)
 - Non-operative management should be the treatment of choice in patients with blunt hepatic injury, with embolization considered with ongoing bleeding, identification of bleeding source on imaging, or suspicion of persistent source of arterial bleed.
 - Embolization should be considered for any hemodynamically stable patients with grade IV/V splenic injury, or imaging/clinical evidence of ongoing hemorrhage
 - Angiography/embolization should be considered for grade III/IV renal injuries when surgical exploration is not warranted for other reasons.

Massive Transfusion

Massive Blood Transfusion



With the Pediatric population, the definitions differ:

- Transfusion of >100% TBV within 24 hours
- Transfusion support to replace ongoing hemorrhage of >10% TBV/min
- Replacement of >50% TBV by blood products within 3 hours

References

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