Hypovolemic Shock Resuscitation

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KEYWORDS

• Hemorrhagic shock • Septic shock • Massive transfusion • Blood loss • Crystalloid

KEY POINTS

- Hypovolemic shock is defined as inadequate tissue perfusion caused by decreased intravascular circulating volume.
- Early transfusion with a 1:1:1 ratio of fresh frozen plasma to platelets to packed red blood cells has been associated with improved outcomes in patients requiring massive transfusion.
- Monitoring coagulation function with thromboelastography or rotational thromboelastometry may be superior to conventional coagulation assays in patients with hypovolemic shock.

DEFINITION OF SHOCK

Shock is the inability of the body to maintain adequate end-organ perfusion. Hypovolemic shock caused by blood loss is frequently encountered after severe injury.[1] Hemorrhagic shock should be assumed to be the cause of hypotension in all trauma patients until proven otherwise. Shock is a strong predictor of mortality, and is a major risk factor for the development of complications, particularly multiple organ dysfunction. Hence, it is important to rapidly identify patients in shock so that appropriate resuscitation can begin as soon as possible. Indicators of shock include elevated heart rate, low blood pressure, narrowed pulse pressure, decreased capillary refill, cool clammy extremities, pale skin, increased skin turgor, low urine output, dry mucus membranes, and alterations in mental status. In certain patients, clinicians must keep in mind that significant blood loss can occur with little effect on vital signs. In particular, pediatric patients have excellent cardiovascular reserve, preventing a drop in blood pressure even in the presence of large volume blood loss. Conversely, elderly patients are often unable to mount a tachycardic response to hemorrhage, or may be on medications that blunt or prohibit normal response to blood loss. Elderly patients often also

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have chronic underlying hypertension, and apparently normal blood pressure may, for them, be relative hypotension.

CLASSIFICATION OF HEMORRHAGIC SHOCK

Hemorrhagic shock is classified according to severity from class I to IV shock (**Table 1**). Class I shock is minor blood loss, often resulting in no significant derangement of vital signs or findings on clinical examination. Severity increases with increasing volumes of blood loss, with class IV shock caused by loss of more than 40% of circulating blood volume and resulting in hypotension, tachycardia, and severe multisystem organ derangements.

MASSIVE BLOOD LOSS AND MASSIVE TRANSFUSION

In addition to the traditional classifications of shock, a subset of patients with extensive injuries causing rapid hemorrhage develop massive blood loss (MBL) (**Box 1**). These patients often require alterations in goals of care from definitive management to damage control, and may require different resuscitation strategies and monitoring. Patients with MBL often require massive transfusion in response to their hemorrhage. Massive transfusion (MT) is typically defined as 10 or more units of packed red blood cells (PRBCs) in a 24-hour period.[2–7] At this level of transfusion, hemodilution of fibrinogen, platelets, and clotting factors can occur as whole blood continues to be lost, and is replaced with only crystalloid or PRBCs. These patients are at high risk for developing acidosis and hypothermia from blood loss, injury burden, and associated need for multicavitary surgery. This acidosis and hypothermia can further exacerbate coagulopathy, resulting in the "bloody vicious triad."[8]

Of all trauma admissions, 8% to 11% of patients will require a blood transfusion during their hospital stay.[5] Only approximately 3% of trauma patients will have blood loss requiring MT, although this percentage may increase to 8% to 15% among busy urban trauma centers and among military casualties.[9–13] As many as 24% of patients presenting in shock will require MT, and those with MT account for up to 60% to 70% of all PRBCs used.[14,15] Mortality increases in a linear fashion with PRBC transfusions and can be as high as 60% to 100% (**Table 2**).[3,9,13–19]

CLASSICAL RESUSCITATION OF SHOCK STATES

The most important step in resuscitation of hemorrhagic shock is identification and rapid control of the source of bleeding, which can be accomplished with direct pressure, application of a tourniquet, suture ligation, or surgery. Although maneuvers to

Table 1
Classes of hemorrhagic shock

	Class I	Class II	Class III	Class IV
Blood loss (mL)	≤750	750–1500	1500–2000	≥2000
Blood loss (% blood volume)	≤15%	15%–30%	30%–40%	≥40%
Pulse rate (BPM)	<100	>100	>120	>140
Blood pressure	Normal	Normal	↓	↓
Pulse pressure	Normal or ↑	↓	↓	↓
Capillary refill	Normal	Delayed	Delayed	Delayed

Abbreviation: BPM, beats per minute.