III. Tissue oxygenation, fluid and hypothermia

R13
Tissue oxygenation
***
A target systolic blood pressure of 80-90 mmHg should be employed until major bleeding has been stopped in the initial phase following trauma without brain injury. A mean arterial pressure ≥80 mmHg should be maintained in patients with combined haemorrhagic shock and severe traumatic brain injury.

R14
Fluid therapy
***
Fluid therapy should be initiated and crystallloids applied initially to treat the hypotensive bleeding trauma patient. Hypotonic solutions such as Ringer's lactate should be avoided in patients with severe head trauma. If colloids are administered, they should be used within the prescribed limits for each solution. Hypertonic solutions may be used during initial treatment and in haemodynamically unstable patients with penetrating torso trauma.

R15
Vasopressors and inotropic agents
***
Vasopressors may be administered to maintain target arterial pressure in the absence of a response to fluid therapy and inotropic agents may be infused in the presence of myocardial dysfunction.

R16
Temperature management
***
Early application of measures to reduce heat loss and warm the hypothermic patient should be employed to achieve and maintain normothermia. Hypothermia at 33-35ºC for ≥48 h may be applied in patients with traumatic brain injury once bleeding from other sources has been controlled.

R17
Erythrocytes
***
Treatment should aim to achieve a target Hb of 7-9 g/dl.

IV. Rapid control of bleeding

R18
Early abdominal bleeding control
***
Early abdominal bleeding control should be achieved using packing, direct surgical bleeding control and local haemostatic procedures; aortic cross clamping may be employed as adjunct bleeding control in the exsanguinating patient.

R19
Pelvic ring closure & stabilisation
***
Patients with pelvic ring disruption in haemorrhagic shock should undergo immediate pelvic ring closure and stabilisation.

R20
Packing, embolisation & surgery
***
Patients with ongoing haemodynamic instability despite adequate pelvic ring stabilisation should undergo early preperitoneal packing, angiographic embolisation and/or surgical bleeding control.

R21
Damage control surgery
***
Damage control surgery should be employed in the severely injured patient presenting with deep hemorrhagic shock, signs of ongoing bleeding and coagulopathy. Severe coagulopathy, hypothermia, acidosis, inaccessible major anatomic injury, a need for time-consuming procedures or concomitant major injury outside the abdomen should also trigger a damage control approach. Primary definitive surgical management should be employed in the haemodynamically stable patient in the absence of any of these factors.

R22
Local haemostatic measures
***
Topical haemostatic agents should be employed in combination with other surgical measures or with packing for venous or moderate arterial bleeding associated with parenchymal injuries.

V. Management of bleeding and coagulation

R23
Coagulation support
***
Monitoring and measures to support coagulation should be initiated as early as possible.

R24
Antifibrinolytic agents
***
Tranexamic acid should be administered as early as possible to the trauma patient who is bleeding or at risk of significant haemorrhage at a loading dose of 1 g infused over 10 min, followed by an intravenous infusion of 1 g over 8 h. Tranexamic acid should be administered to the bleeding trauma patient within 3 h after injury. Protocols for the management of bleeding patients may consider administration of the first dose of tranexamic acid en route to the hospital.

R25
Calcium
***
Ionised calcium levels should be monitored and maintained within the normal range during massive transfusion.

R26
Plasma
***
Plasma or fibrinogen should be administered initially in patients with massive bleeding. If further plasma is administered, an optimal plasma:red blood cell ratio may be at least 1:2. Plasma transfusion should be avoided in patients without substantial bleeding.

R27
Fibrinogen & cryoprecipitate
***
Fibrinogen concentrate or cryoprecipitate should be administered if significant bleeding is accompanied by thromboelastometric signs of a functional fibrinogen deficit or a plasma fibrinogen level of less than 1.5-2.0 g/l; an initial fibrinogen dose of 3-4 g or 50 mg/kg of cryoprecipitate, approximately equivalent to 15-20 single donor units in a 70 kg adult, may be employed. Repeat doses may be guided by viscoelastic monitoring and laboratory assessment of fibrinogen levels.

R28
Platelets
***
Platelets should be administered to maintain a platelet count above 50×10^9/l. A platelet count above 100×10^9/l in patients with ongoing bleeding and/or traumatic brain injury may be maintained. An initial dose of 4-8 platelet concentrates or one aphaeresis pack may be used.

R29
Antiplatelet agents
***
Platelets may be administered in patients with substantial bleeding or intracranial haemorrhage who have been treated with antiplatelet agents. Desmopressin (0.3 µg/kg) may be administered if the patient has been treated with acetylsalicylic acid alone. Platelet function may be measured in patients treated or suspected of being treated with antiplatelet agents. Platelet concentrates may be used if platelet dysfunction is documented in a patient with continued microvascular bleeding.

R30
Desmopressin
***
Desmopressin (0.3 µg/kg) may be administered in patients treated with platelet-inhibiting drugs or with von Willebrand disease. Desmopressin may not be administered routinely in the bleeding trauma patient.

R31
Prothrombin complex concentrate
***
Prothrombin complex concentrate (PCC) should be used early for the emergency reversal of vitamin K-dependent oral anticoagulants. PCC may be administered in the bleeding patient with thromboelastometric evidence of delayed coagulation initiation if a concentrate-based goal-directed strategy is applied.

R32
Novel anticoagulants
***
Substrate-specific anti-factor Xa activity may be measured in patients treated or suspected of being treated with oral anti-factor Xa agents such as rivaroxaban, apixaban or endoxaban. Reversal may be achieved with high-dose (25-50 U/kg) PCC if bleeding is life-threatening. PCC may not be administered in patients treated or suspected of being treated with oral direct thrombin inhibitors such as dabigatran.

R33
Recombinant activated coagulation factor VII
***
Treatment with recombinant activated coagulation factor VIIa (rFVIIa) may be considered if major bleeding and traumatic coagulopathy persist despite standard attempts to control bleeding and best-practice use of conventional haemostatic measures. rFVIIa may not be used in patients with intracranial haemorrhage caused by isolated head trauma.

R34
Thromboprophylaxis
***
Mechanical thromboprophylaxis with intermittent pneumatic compression and/or anti-embolic stockings may be applied as soon as possible. Pharmacological thromboprophylaxis should be employed within 24 h after bleeding has been controlled. Inferior vena cava filters as thromboprophylaxis should not be routinely employed.