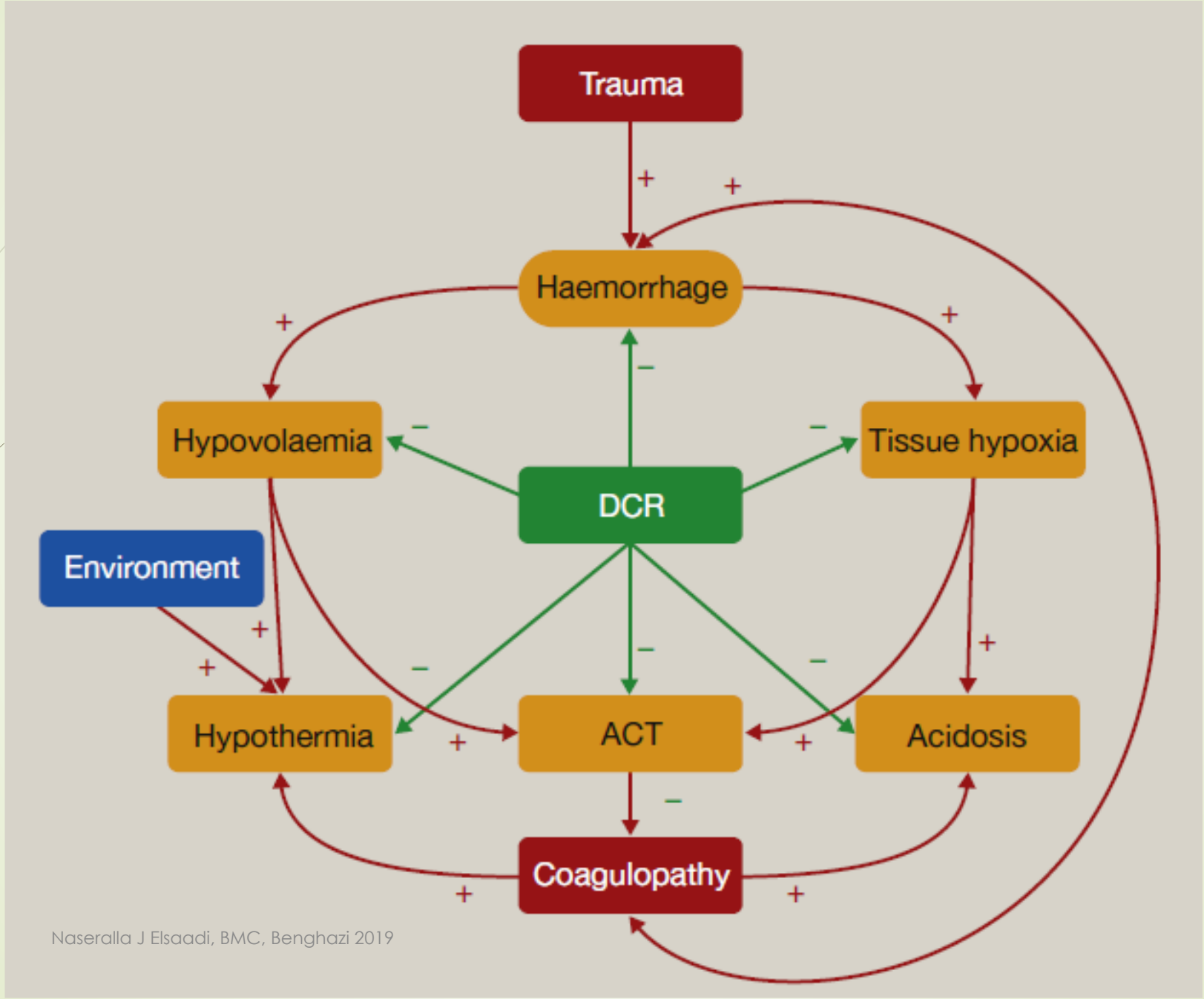

Naseralla J Elsaadi, BMC, Benghazi 2019

Haemorrhage and Blood Transfusion

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The Curriculum is competence based, requiring the trainee to demonstrate both applied and theoretical knowledge and practical skills, together with the professional behaviours described in good medical practice document.

Haemorrhage and Blood Transfusion

Learning Objectives

- Acknowledge the classification of haemorrhage
- Appreciate Pathophysiological response to haemorrhage and clinical picture of haemorrhage
- Know the Blood transfusion principles, Blood groups & blood cross matching
- Consider the Blood products - Types & indications
- Mean of the Massive blood transfusion
- Complications of blood transfusion & management
- Alternative to homologous blood transfusion

HAEMORRHAGE

PRINCIPLES

- Haemorrhage must be recognised and managed aggressively to reduce the severity and duration of shock and avoid death and/ or multiple organ failure.
- Haemorrhage is treated by arresting the bleeding – not by fluid resuscitation or blood transfusion, instead.
- Attempting to resuscitate those who have ongoing haemorrhage will lead to physiological exhaustion (coagulopathy, acidosis and hypothermia) and subsequently death.

Abstract

- Haemorrhagic and severe hypovolaemic shock can be rapidly fatal unless identified and resuscitated quickly.
- Monitoring of haemodynamic and cellular end points is crucial in guiding treatment and improving outcomes.
- Fluid resuscitation saves lives but considerable debate remains regarding the ideal fluid type and strategy to use.

Introduction

‘Major haemorrhage’ is defined as:

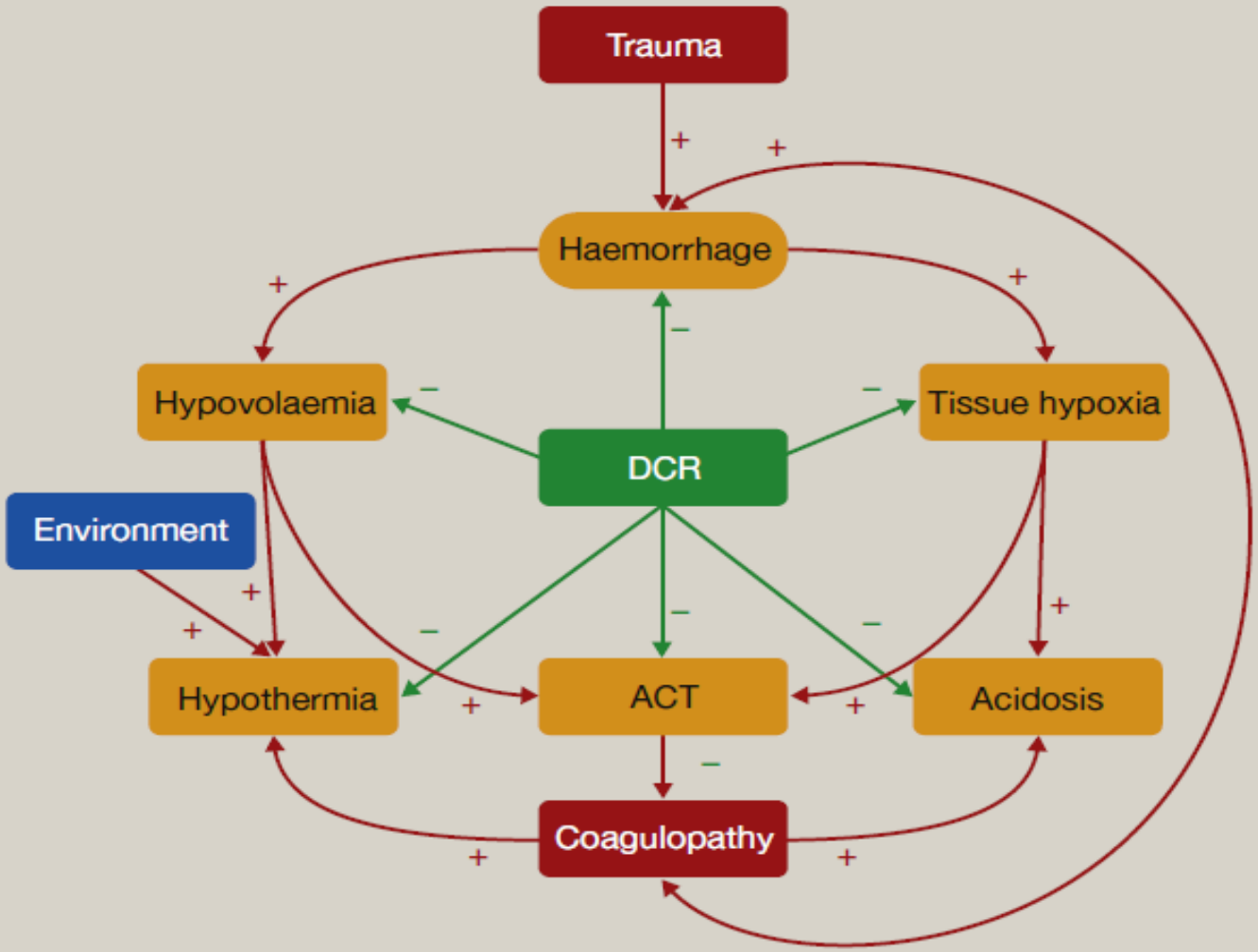
- loss of more than total blood volume within 24 hours (around 70 ml/kg, >5 litres in a 70-kg adult);
- 50% of total blood volume lost in less than 3 hours bleeding in excess of 150 ml/minute;
- bleeding which leads to a systolic blood pressure of less than 90 mmHg or a heart rate of more than 110 beats per minute.

Pathophysiology

Haemorrhage leads to a state of hypovolaemic shock. The combination of tissue trauma and hypovolaemic shock leads to the development of an endogenous coagulopathy called acute traumatic coagulopathy (ATC).

Ongoing bleeding with fluid and red blood cell resuscitation leads to a dilution of coagulation factors which worsens the coagulopathy.

Process of trauma-induced coagulopathy and damage control resuscitation



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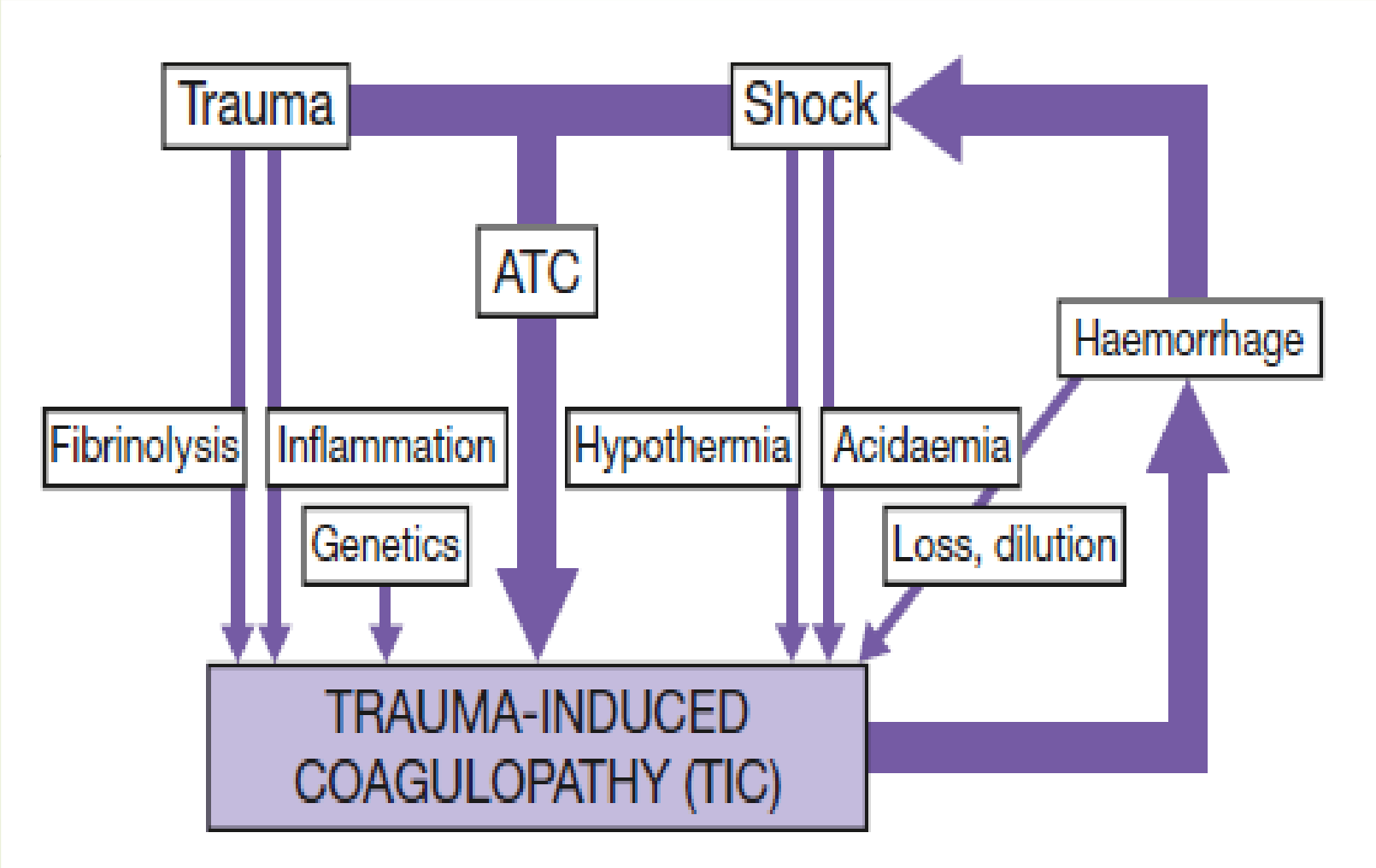
Trauma
Shock
ATC
Haemorrhage
Fibrinolysis
Inflammation
Hypothermia
Acidaemia
Genetics
Loss, dilution
TRAUMA-INDUCED
COAGULOPATHY (TIC)

Pathophysiology

Every effort must therefore be made to rapidly identify and stop haemorrhage, and to avoid (preferably) or limit physiological exhaustion from coagulopathy, acidosis and hypothermia.

Haemorrhage - Definitions

- Revealed and concealed haemorrhage
- Primary, reactionary and secondary haemorrhage
- Surgical and non-surgical haemorrhage

Degree of haemorrhage and classification

The adult human has approximately 5 litres of blood (70 mL/kg children and adults, 80 mL/kg neonates).

Estimation of the amount of blood that has been lost is difficult, inaccurate and usually underestimates the actual volume.

Assessment and classification of blood loss[3]

	Class I	Class II	Class III	Class IV
Blood loss (ml)	Up to 750	750–1500	1500–2000	>2000
Blood loss (% blood vol)	Up to 15	15–30	30–40	>40
Pulse rate	<100	100–120	120–140	>140
Blood pressure	Normal	Normal	Decreased	Decreased
Pulse pressure (mmHg)	Normal or increased	Decreased	Decreased	Decreased
Respiratory rate	14–20	20–30	30–40	>35
Urine output (ml/hour)	>30	20–30	5–15	Negligible
CNS/mental status	Slightly anxious	Mildly anxious	Anxious, confused	Confused, lethargic
Fluid replacement	Crystalloid	Crystalloid	Crystalloid and blood	Crystalloid and blood

Management

Identify haemorrhage

- External haemorrhage may be obvious, but the diagnosis of concealed haemorrhage may be more difficult.
- Any shock should be assumed to be hypovolaemic until proven otherwise and, similarly, hypovolaemia should be assumed to be due to haemorrhage until this has been excluded.

Resuscitation

Haemodynamically unstable patients should be simultaneously assessed and resuscitated.

High-flow oxygen should be administered via a non-rebreathe mask (Hudson mask).

Intravenous access should be achieved with two large-bore cannulae in the antecubital fossae.

Bloods should be taken for full blood count, coagulation studies, urea and electrolytes, liver function, amylase, lactate, venous gas and cross-matching, initiating the hospital's major haemorrhage protocol if required.

Haemorrhage control places

The bleeding, shocked patient must be moved rapidly to a place of haemorrhage control. This will usually be in the operating room but may be the angiography or endoscopy suite.

Resuscitation

- The main goal of resuscitation is to restore circulating blood volume;
- Patients with on-going bleeding should have their circulating blood volume restored as soon as possible;
- Therapy should be guided by changes in haemodynamic parameters including blood pressure, heart rate, urine output and where invasive monitoring is indicated, central venous pressure, cardiac output, pulmonary wedge pressure and oxygen saturation.

Damage control resuscitation (DCR)

These concepts have been combined into a new paradigm for the management of trauma patients with active haemorrhage

The four central strategies of DCR are:

1 Anticipate and treat acute traumatic coagulopathy (ATC).
2 Permissive hypotension until haemorrhage control.
3 Limit crystalloid and colloid infusion to avoid dilutional coagulopathy.
4 Damage control surgery to control haemorrhage and preserve physiology.

American College of Surgeons Advanced Trauma Life Support (ATLS) responses to initial fluid resuscitation[a,3]

	Rapid response	Transient response	Minimal or no response
Vital signs	Return to normal	Transient improvement, recurrence of decreased blood pressure and increased heart rate	Remain abnormal
Estimated blood loss	Minimal (10–20%)	Moderate and ongoing (20–40%)	Severe (>40%)
Need for more crystalloid	Low	High	High
Need for blood	Low	Moderate to high	Immediate
Blood preparation	Type and crossmatch	Type-specific	Emergency blood release
Need for operative intervention	Possibly	Likely	Highly likely
Early presence of surgeon	Yes	Yes	Yes

[a] 2000 ml of isotonic solution in adults; 20 ml/kg bolus of Ringer's lactate in children.

BLOOD TRANSFUSION

- The transfusion of blood and blood products has become commonplace since the first successful transfusion in 1818.
- there is an immunological price to be paid from the transfusion of heterologous blood, leading to increased morbidity .
- Supplies are also limited, and therefore the use of blood and blood products must always be judicious and justifiable for clinical need.

Causes of anaemia in surgical and critically ill patients

- Blood loss
- Haemodilution
- Frequent phlebotomy
- B12 or folate deficiency
- Reduced red cell survival or production
- Low erythropoietin levels
- Functional iron deficiency

Blood and blood products

- Whole blood
- Packed red blood cells
- Fresh-frozen plasma
- Cryoprecipitate
- Platelets
- Prothrombin complex concentrates
- Autologous blood

Indications for blood transfusion

Blood transfusions should be avoided if possible, and many previous uses of blood and blood products are now no longer considered appropriate.

The indications for blood transfusion are as follows:

- Acute blood loss, to replace circulating blood volume and maintain oxygen delivery;
- Perioperative anaemia, to ensure adequate oxygen delivery during the perioperative phase;
- Symptomatic chronic anaemia, without haemorrhage or impending surgery.

A haemoglobin level of >6 g/dL is acceptable in patients who are not actively bleeding, not about to undergo major surgery and are not symptomatic.

TABLE 2.6 Perioperative red blood cell transfusion criteria.

Haemoglobin level (g/dL)	Indications
<6	Probably will benefit from transfusion
6–8	Transfusion unlikely to be of benefit in the absence of bleeding or impending surgery
>8	No indication for transfusion in the absence of other risk factors

Historically, patients were transfused to achieve a haemoglobin >10 g/dL. This has now been shown not only to be unnecessary but also to be associated with an increased morbidity and mortality compared with lower target values.

Blood groups and cross-matching

Human red blood cells have on their cell surface many different antigens. Two groups of antigens are of major importance in surgical practice – the ABO and rhesus systems.

Phenotype	Genotype	Antigens	Antibodies	Frequency (%)
O	OO	O	Anti-A, anti-B	46
A	AA or AO	A	Anti-B	42
B	BB or BO	B	Anti-A	9
AB	AB	AB	None	3

The other minor blood group antigens may be associated with naturally occurring antibodies, or may stimulate the formation of antibodies on relatively rare occasions.

Traditional blood group compatibility

Recipient	Red Cell Donor								
		A+	A-	B+	B-	AB+	AB-	O+	O-
	A+	safe	safe					safe	safe
	A-		safe						safe
	B+			safe	safe			safe	safe
	B-				safe				safe
	AB+	safe	safe	safe	safe	safe	safe	safe	safe
	AB-		safe		safe		safe		safe
	O+							safe	safe
	O-								safe
	O negative "The universal donor"								

AB+ "The universal recipient"

Transfusion reactions

If antibodies present in the recipient’ s serum are incompatible with the donor’ s cells, a transfusion reaction will result. This usually takes the form of **an acute haemolytic reaction**.

Cross matching

To prevent transfusion reactions, all blood transfusions are preceded by ABO and rhesus typing of both donor and recipient blood **to ensure compatibility**.

The recipient’ s serum is then mixed with the donor’ s cells to confirm ABO compatibility and to test for rhesus and any other minor blood group antigen–antibody reaction.

Urgency of starting Blood Transfusion

Pack 1: 4 units of Type 'O' Rh Negative Red cells

Pack 2: (and each subsequent pack)

- 6 units Type Specific Blood
- 5 units Fresh Frozen Plasma
- 1 Bag Platelets +/- Cryoprecipitate dependant on fibrinogen Levels

(N.B. pack 2 requires a 15-min cross-match for type specificity)

Complications of blood transfusion

Complications from blood transfusion can be categorised as:

- those arising from a single transfusion; and
- those related to massive transfusion.

Management of coagulopathy

- Correction of coagulopathy is not necessary if there is no active bleeding and haemorrhage is not anticipated (not due for surgery).
- However, coagulopathy following or during massive transfusion should be anticipated and managed aggressively.
- Prevention of dilutional coagulopathy is central to the damage control resuscitation of patients who are actively bleeding.

Blood substitutes

Blood substitutes are an attractive alternative to the costly process of donating, checking, storing and administering blood, especially given the immunogenic and potential infectious complications associated with transfusion.

Blood substitutes

Advantages	Disadvantages
Not limited by number of donors	Currently expensive
If mass produced could be cheaper	Not widely available for commercial use
Significantly reduced infective complications	Novel therapies that are as yet unproven
Fewer ethical objections	Many substitutes withdrawn due to unacceptable adverse
Longer storage time	CVS and renal events
No need to refrigerate	
Allow for full immediate oxygen carrying capacity	

Summary – Trauma as a main Cause

- Complex trauma should be managed by dedicated trauma teams with individual team members having defined roles.
- The primary survey and immediate life-saving interventions should be undertaken promptly and at times simultaneously.
- Managing trauma is challenging; following a standardized clear process, remembering to reassess from the top if any changes in clinical condition or treatment occur will allow life threatening injuries to be identified and treated in a timely fashion.

Conclusions

- Haemorrhagic and severe hypovolaemic shock can be rapidly fatal unless identified and resuscitated quickly.
- Fluid resuscitation saves lives but considerable debate remains regarding the ideal fluid type and strategy to use.
- Blood transfusion is a critical therapy in the shocked, bleeding patient with lower thresholds for transfusion appropriate in the elderly patient.

Conclusions

- However, coagulation products should support both fluid and red cell therapy in order to manage the multifactorial coagulopathy that accompanies severe trauma, haemorrhage and shock with interventional strategies considered for uncontrolled bleeding.
- Monitoring haemodynamic and cellular end points is crucial in guiding treatment and improving outcomes in this critically ill group of patients.

THANKS FOR YOUR ATTENTION

The Italian Lighthouse of Benghazi