ROLE OF TRANSFUSION MEDICINE CONSULTANT IN MANAGING BLEEDING DUE TO TRAUMA

Col (Dr) Joseph Philip, Commanding Officer Transfusion Centre, Command Hospital, Kolkata
OUTLINE

• Introduction
• Historical backdrop
• Acute management of Hemorrhagic shock
• Component therapy
• Emerging technologies
INTRODUCTION

• Hemorrhagic shock is the second most frequent cause of death in trauma patients and is the leading cause of early in-hospital trauma deaths.

• Mainstay of therapy:
  Surgical control of bleeding
  Volume Resuscitation
INTRODUCTION

Issues:

- Blood products remains a vital resource: Cost issues
- Risk of TTIs: existing as well as emerging
- Little evidence to help guide clinical transfusion decisions.
INTRODUCTION

• Rational approach to using blood products:
  – Find out reliable end points of resuscitation
  – Improve perfusion and oxygen delivery to tissues
  – Avoiding over/unnecessary transfusion
  – Special care in cases of Massive transfusion (~3%)

• A recent re-evaluation of transfusion practice!!

  “Restrictive transfusion policy”
HISTORICAL PERSPECTIVE
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• Lessons Learnt: **Boer war, the Spanish civil war & World war I and II**

• Managing trauma patients in hemorrhagic shock state with whole blood (Europeans) / plasma components (Americans).

• The Russians maintained a steady pool of WB donors recruited mainly from the non warrior class & women.
HISTORICAL PERSPECTIVE

• In the post-war era, transfusion was considered relatively risk-free.

• More Liberal Approach i.e. Hb cut off for transfusion: < 10 g/dL irrespective of clinical status.

• However, the discovery that blood transfusion could transmit HIV and hepatitis C virus (HCV) led to a re-evaluation of transfusion practices.
The concept comes from U.S. Military wartime experience, particularly in the Vietnam War.

The golden hour is the first 60 minutes after the occurrence of a major multisystem trauma.

Definitive treatment within the Golden Hour.

The golden hour can be summarized by the 3R rule of Dr. Donald Trunkey, an academic trauma surgeon, “Getting the right patient to the right place at the right time”.

HISTORICAL PERSPECTIVE
ACUTE MANAGEMENT OF HEMORRHAGIC SHOCK

• General principles

• Volume resuscitation

• Control of hemorrhage: Damage control surgery

• Better end points of resuscitation

• Component therapy

• Transfusion in resuscitated, non-bleeding patients
VOLUME RESUSCITATION vs CONTROL OF HEMORRHAGE

• ATLS advocates 2 interventions:
  – control of hemorrhage
  – reversal of hypovolemia

• Controversy over which should be corrected first and with what solution.

• “Permissive hypotension”

• Vigorous volume replacement is still appropriate in patients with blunt injury, because brain injury commonly complicates blunt trauma and hypotension further increases the risk of death for patients with brain injury.
• In adult hypotensive patients, ATLS calls for a rapid infusion of 2 L of an \textit{isotonic crystalloid solution}.

• A \textbf{second bolus}: if there is NO response or if there is only a transient response.

• \textbf{Red cell transfusions}: for transient or initial non-responders.
Type of blood to be issued:

- **Cross-matched blood**: if the patient's clinical status permits the 45-minute wait for the full cross-matching process.

- If the situation is emergent, group-specific blood is used where possible, to avoid depleting type-O stock.

- As a last resort, use type O Negative blood in young women and type O+ in all other patients, when uncross-matched blood is required.
VOLUME RESUSCITATION

- Red cell salvage (auto-transfusion) is another strategy developed to reduce exposure to allogeneic blood.

- Reduces transfusion in elective surgery; however, there is no evidence to support its use in trauma.

- Potential disadvantage: possible development of coagulopathy from the anticoagulant, which is used in the cell salvage process.
A) **Surgical bleeds** originate from lacerated vessels at the site of injury: identified during primary survey.

B) **Coagulopathic bleeds** results from a complex, multifactorial process and commonly develops after severe injury (44% of all seriously injured patients).

- Massive hemorrhage after traumatic injury is frequently a combination of surgical and coagulopathic bleeding.
TRAUMA

- Fluid administration
- Operative exposure

DEATH TRIAD

Hemorrhage

Coagulopathy

Acidosis

Hypothermia
COAGULOPATHIC BLEEDING

• Based mostly on:
  – military experience emerging from the Iraq and Afghanistan wars
  – from civilian clinical practice reviews
  – International Consensus Conference

• It has been proposed that coagulopathic trauma patients be primarily resuscitated with thawed FFP in a ratio of 1:1:1 to red blood cells and platelets, virtually receiving high value “reconstituted whole blood.”
CORRECTION OF FACTORS LEADING TO COAGULOPATHY

• Recognition and treatment of shock is necessary to minimize metabolic acidosis.

• Most importantly, hypothermia should be aggressively treated and prevented.
  
  – Use of environmental and fluid warmers

  – Its use should be instituted after the transfusion of the sixth unit of blood product

• Appropriate therapy with blood products should be instituted.
“DAMAGE CONTROL” SURGERY

• These techniques have been advocated to reduce operative time and allow for early transport to the ICU.

• **Principle:**
  
  – Immediate organ repairs **may be detrimental.**

  – **Staged operations** allow for rewarming and resuscitation and can potentially interrupt the vicious cycle.
“DAMAGE CONTROL” SURGERY

• The 3 stages of damage control surgery are:

  a) Limited operation for control of hemorrhage and contamination, with packing of potential spaces

  b) Resuscitation in the ICU

  c) Re-operation for definitive repairs and completion of GI anastomosis.
• ATLS cautions against using hemoglobin level as a guide for resuscitation.

• Minimum hemoglobin level of above 7 g/dl during this resuscitative phase.

• The primary goal of transfusing red cells is to enhance tissue perfusion and oxygen delivery.

• PRBC transfusions should be guided by the rate of ongoing bleeding and by signs and symptoms of inadequate tissue perfusion.
BETTER END POINTS OF RESUSCITATION

• Traditional clinical signs of shock include:
  – heart rate of over 120 beats per minute
  – systolic blood pressure less than 90 mm Hg or
  – urine output of less than 15 mL/hour

• Fluid resuscitation with crystalloid and blood products is required when these parameters are abnormal.
BETTER END POINTS OF RESUSCITATION

• Up to 85% of patients with severe injury have other biochemical evidence of inadequate tissue oxygenation:
  – compensated shock

• Recognition and reversal of this state can minimize the risk of death and subsequent development of multiple organ failure.
BETTER END POINTS OF RESUSCITATION

• After bleeding has been controlled and hemodynamics are normalized, several different laboratory measures for persistent metabolic acidosis:
  – base deficit, bicarbonate, and lactate

• A persistent base deficit or elevated lactate suggests ongoing resuscitation requirements.
BETTER END POINTS OF RESUSCITATION

• Other tests have been shown to be useful:
  
  – Gastric mucosal pH testing
  
  – Right ventricular end-diastolic volume index (RVEDVI)
  
  – Oxygen extraction (> 50%), partial pressure of mixed venous oxygen (< 25 mm Hg) and mixed venous oxygen saturation (< 50%)
Platelets:

- Platelets are crucial to the clotting process by forming a platelet plug.

- Bleeding is unlikely to be aggravated by thrombocytopenia when the platelet count is greater than 50,000/μL.

- Maintaining a platelet count above 100,000/μL has been recommended if head injury is present.
COMPONENT THERAPY

Fresh frozen plasma (FFP):

• Appropriate coagulation requires a minimum concentration of clotting factors that is 20%–30% of normal.

• Four units of FFP (10–15 mL/kg) is the calculated dose that will raise the concentration of blood clotting factors to 30% of normal.
COMPONENT THERAPY

Cryoprecipitate:

• In trauma patients, cryoprecipitate is used to replace fibrinogen and is indicated for levels less than 1.0 g/L.

• However, it’s administration results in high donor exposure.
ACUTE MANAGEMENT OF HEMORRHAGIC SHOCK

• **Emerging technologies:**

  – Fibrin sealants/ Fibrin glue/ platelet glue
  
  – Antifibrinolytics
  
  – Artificial Blood (HBOC)
  
  – POC testing: TEG/Sonoclot
  
  – Recombinant factor VIIa (Novoseven)
  
  – Others
Thromboelastography (TEG):

- It rapidly assesses the coagulation cascade, starting from the initial platelet-fibrin interaction through to clot lysis.
- Reduces allogeneic blood exposure
- Both FFP and platelet use gets diminished with the use of TEG, with no adverse effects on blood loss or on rates of reoperation for bleeding.
EMERGING INTERVENTIONS

Anti-fibrinolytic agents:

• Widely used in major surgery to prevent fibrinolysis and reduce surgical blood loss.

• Attractive drugs for treating coagulopathy in trauma patients, but they require well-designed prospective studies to delineate their use in this setting.
EMERGING INTERVENTIONS

Anti-fibrinolytic agents

- Streptokinase
- Urokinase
- Alteplase

Fibrinolytics

Plasminogen

Plasmin

EACA
Tranexamic acid
Aprotinin

Antifibrinolytics
Recombinant activated factor VIIa (rFVIIa):

- Approved for hemophilia patients with inhibitors.
- Recently, it has been used as a hemostatic agent in trauma patients with massive bleeding.
- Adverse events including DIC and thromboembolic events.
- It can be used as an adjunct to surgical control of hemorrhage in patients with massive bleeding, after transfusion of 8 units of PRBCs and if there is still evidence of ongoing bleeding.
EMERGING INTERVENTIONS

Recombinant activated factor VIIa (rFVIIa):
EMERGING INTERVENTIONS

Artificial hemoglobin-based oxygen carriers (HBOC):

• Red cell membranes are removed from outdated red cells and the hemoglobin molecules are cross-linked to prolong shelf-life.

• Currently in phase III testing, in large prospective pre-hospital trauma and elective surgery studies.

ARTIFICIAL BLOOD FOR THE FUTURE?

Could this really mark the end of blood donations?
EMERGING INTERVENTIONS

Use of new FDA approved additive solutions (AS 7):

• They have increased the shelf life of RBCs to 8 weeks enabling blood and its derivatives to be transported to the far-flung areas in the most difficult terrains of CI Ops.

Apheresis in peripheral hospitals:

• The transfusion experiences from Gulf War have shown that installation of Apheresis technology in peripheral hospitals have contributed significantly in bringing down the mortality and morbidity in field trauma cases.
EMERGING INTERVENTIONS

Use of Glycerolized frozen packed RBC:

• It is a modality of long term blood storage and stored up to ten years
CONCLUSION

✓ Trauma patients with massive bleeding are complex and difficult to manage.

✓ A rational approach to using blood products in patients with bleeding requires an understanding of the principles of managing hemorrhagic shock.

✓ Surgical control and treatment of coagulopathy are required to stop hemorrhage in these patients.
✓ **Resuscitation with fluids and red cells** are necessary to improve perfusion and oxygen delivery to tissues.

✓ However, **avoidance of over transfusion** is the key because transfusion is also associated with significant risks.
The trend toward reducing allogeneic blood exposure will likely to continue.

Fortunately, new technologies are being developed that have the potential of reducing blood loss and transfusion requirements in trauma patients with massive bleeding.
THANK YOU!!:}