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Massive Transfusion and the Role of Plasma Components Thawed Plasma vs. Liquid Plasma

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Disclosures: Nothing to Disclose

About TMCP

- HCA facility
- Established in 1975
- Full service, 498 beds acute-care facility
- More than 1,600 employees and over 1,000 physicians
- 70 specialties and subspecialties
- Trauma II designation **(pending Trauma 1)**
- Comprehensive Women's Services
- NICU Trauma III designation
- Comprehensive stroke accreditation
- Neuroscience care, included advanced treatments for brain cancer
- **Burn & Reconstructive Centers of Texas**
- Magnet recognition from the American Nurses Association

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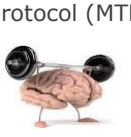
Learning Objectives

- Discuss definition and purpose of massive transfusion protocol (MTP)
- Discuss damage control resuscitation and the role of plasma components
- Provide an overview of thawed plasma and liquid plasma (LP) widely used in massive transfusion protocol (MTP) at TMCP



The Facts About Trauma in the U.S.

- Life Years Lost (2014, most recent available)
- Trauma injury accounts for 30% of all life years lost in the U.S.
- Cancer accounts for 16%
- Heart disease accounts for 12%
- Economic Burden
- **$671 billion a year,** including both health care costs and lost productivity
- Deaths Due to Injury
- 192,000
- Ranking as Cause of Death
- #1 for age group 1-46, or 47% of all deaths in this age range
- #3 as leading cause of death overall, across all age groups

Definition and Purpose of MTP

- **Can be defined as:**

->10 units of RBCs transfused over 24 hours
->20 units of RBCs transfused over hospital stay
-One (1) total blood volume (TBV) replacement in 24 hours
or 50% of TBV replacement within 3 hours

- **Purpose:**
- To provide blood products to hemodynamically unstable patients in an immediate and sustained manner
- Massive Transfusion Protocols (MTP) have developed as a part of better patient blood management
- Protocols activated when a patient is experiencing massive bleeding

Formula-driven Massive Transfusion

- Prearranged delivery system of blood products in various proportions:
- RBC
- **Plasma**
- Platelets
- Cryoprecipitate
- Optimal ratio of blood products has not been clearly determined. (More research and recommendation in favor towards ratio 1:1:1, RBC: plasma: platelets (if random used))
- Great variability in practice across hospitals
- Patient don't live longer because of the transfusion ratio, they live long enough to get to the transfusion ratio

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Top Reason for MTP

- Trauma
- GI Bleeding
- Cardiovascular Surgery
- Liver transplant
- Obstetric complications

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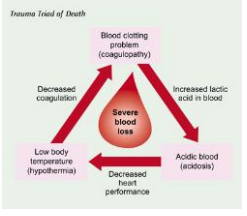
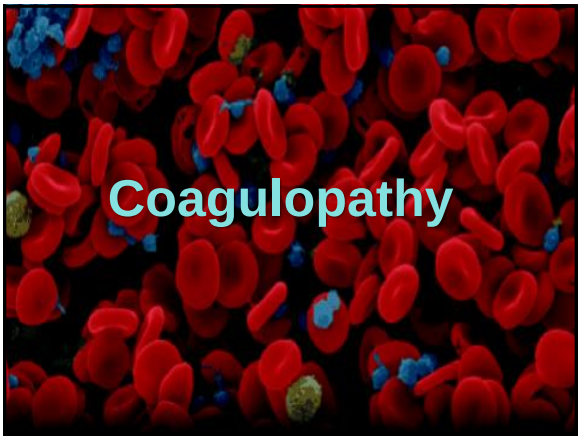
What to Address

- Hemorrhage control
- Hypothermia
- Acidosis
- Coagulopathy





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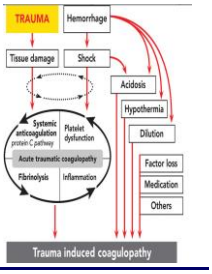
Coagulopathies Associated with Major Bleeding

- Consumption
- Dilution
- Hypoxia and Acidosis
- Hypothermia



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Damage Control Resuscitation

- 40% of injury related death is due to uncontrolled bleeding and ½ of those deaths occur in hospitals
- What can WE do about it from Blood Bank perspective ?

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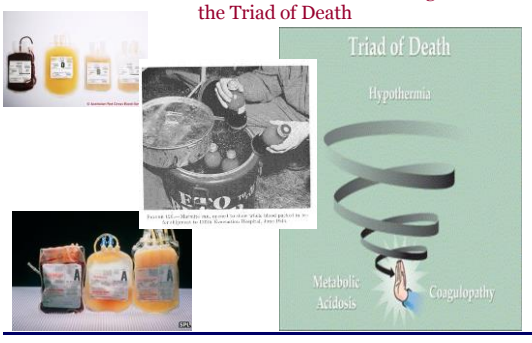
The Role of Transfusion in Preventing the Triad of Death



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To Much Crystalloids in Acute hemorrhage…
Benefit or Harm???

- Cause **dilutional coagulopathy**
- Do little for the oxygen carrying capacity
- Do NOT help with correction of anaerobic metabolism
- Do NOT help correct the oxygen debt associated with shock
- Unwarmed they lead to **hypothermia**
- Associated with **hyperchloremic acidosis**
- Do NOT stay in the intravascular system

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Benefits of Plasma

- Correction of coagulopathy is considered to be the primary mechanism of action
- Plasma buffers severe acidosis
  - has a buffering capacity 50 times that standard crystalloid products
  - via its high citrate content in hemorrhagic shock patients
- Compared to traditional resuscitation fluids, plasma maintains vascular endothelium integrity and clot stability

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Time is Everything

- Massive transfusion is best survived with expedient transfusion of blood and blood components

- Trauma patients need Blood and Plasma early!

Blood Bank Dilemma

Blood Bank and Rapid Availability of Plasma in Emergency Situations

- Benefits
- Wastage (due to breakage and/or expiration)
- Costs

-The largest expenditure for most laboratories is the budget for blood products

- As costs go up the lab has to
  - Reduce expense
  - Decrease risk
  - BUT First Do No Harm

Plasma Components

- Prepared from whole blood or by apheresis collection
- Non-cellular portion of blood separated and frozen after donation
- Contains all clotting factors (labile and stable)
- The anticoagulant solution used and the component volume are indicated on the label
- Volume varies-on average
  - Whole blood prepared plasma (200-250 mL)
  - Apheresis prepared plasma (400-600mL)

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Plasma Components-Quick Overview

Component	Storage	Transport	Expiration	Additional Criteria	
Fresh Frozen Plasma (FFP)	≤-18 °C or ≤-65 °C	Maintain frozen state	12 months ≤-18 °C or 7 years ≤-65 °C (requires FDA approval)	Frozen at -18ºC or colder within 6-8 hours of collection	Contains quantities of all coagulation factors
FFP (after thawing)	1-6°C	1-10°C	If issued as FFP 24hours	Thaw at 30-37°C or using FDA – cleared device	
PF24	≤-18 °C	Maintain frozen state	12 months from collection	Frozen at -18ºC or colder within 24 hours of collection	Reduced levels of F VIII by 16-24 % and FV (minimum or no reduced)
PF24 (after thawing)	1-6°C	1-10°C	If issued as PF24 24hours	Thaw at 30-37°C or using FDA – cleared device	

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Plasma Components-Quick Overview

Component	Storage	Transport	Expiration	Additional Criteria	
Plasma Cryoprecipitate Reduced	≤-18 °C	Maintain frozen state	12 months from collection		Decreased levels of fibrinogen, factor VII, vWF, fibrinectin, and FVIII
Plasma Cryoprecipitate Reduced (after thawing)	1-6°C	1-10°C	If issued as Plasma Cryoprecipitate Reduced 24hours	Thaw at 30-37°C or using FDA –cleared device	For transfusion or plasma exchange in patients with TTP It may be used to provide clotting factors except fibrinogen, Factor VIII, Factor XIII, and vWF
Thawed Plasma Cryoprecipitate Reduced	1-6°C	1-10°C	5 days from date product was thawed or original expiration whichever is sooner	Shall have been collected and processed in **a closed system**	

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Plasma Components-Quick Overview

Component	Storage	Transport	Expiration	Additional Criteria	
PF24RT24	≤-18 °C or colder	Maintain frozen state	12 months from collection	PF24RT24 held at room temperature up to 24 h after phlebotomy	Reduced levels of Factors V, VIII, and Protein C
PF24RT24 (after thawing)	1-6°C	1-10°C	If issued as PF24RT24 24hours	Thaw at 30-37°C or using FDA –cleared device	
Thawed Plasma	1-6°C	1-10°C	**5 days from date product was thawed** or original expiration whichever is sooner	Shall have been collected and processed in **a closed system**	Reduced levels of factors V and VIII
Liquid Plasma	1-6°C	1-10°C	5 days after expiration of Whole Blood	Never Frozen	Levels and activation state of coagulation proteins are variable

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Dried Plasma –Future?

- Dried plasma products are available in France, Germany, South Africa, and a limited number of other countries.

(A) French Lyophilized Plasma (FLYP), produced by the French Military Blood Institute (Centre de Transfusion Sanguine des Armees [CTSA]); (B) LyoPlas N-w, produced by the German Red Cross; (C) Bioplasma FDP, produced by National Bioproducts Institute, Pinetown, South Africa. TRANSFUSION Volume 56, April 2016

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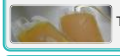
Plasma Indications

Management of preoperative or bleeding patients who require replacement of multiple plasma coagulation (eg, liver disease, DIC)

Patients taking warfarin who are bleeding or need to undergo an invasive procedure before vitamin K could reverse the warfarin effect

Initial treatment of patients undergoing massive transfusion who have clinically significant coagulation deficiencies



Transfusion or plasma exchange in patients with TTP

Used when specific concentrates are not readily available

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Contraindications

- Volume Expander
- Nutritional Source
- Enhancement of wound healing

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Liquid Plasma

- Never-frozen blood product composed of plasma separated from whole blood at any time from collection up to 5 days after the whole blood unit expires
- Liquid Plasma **typically** has a maximum shelf life of 26 days (CPD anticoagulant used) and is stored refrigerated at 1-6°C
- Serves as a source of plasma proteins.
- However, levels and activation state of coagulation proteins are variable and change over time (limited data on the clinical use)

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Liquid Plasma

- Growing numbers of trauma centers are using Liquid Plasma as a "bridge" to a thawed plasma component such as FFP or PF24

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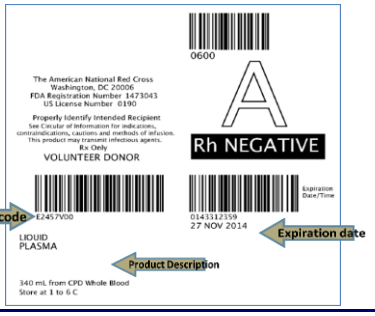
ISBT Label



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Liquid Plasma

- MUST be ABO compatible
- Plasma Rh Substitutions: The Rh factor does not matter in plasma units, as they contain no RBC's

Patient Blood Type (ABO Group)	1st Choice	2nd Choice	3rd Choice	4th Choice
O	O	A	B	**AB**
A	A	AB		
B	B	AB		
AB	**AB**			

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Liquid Plasma

- Liquid Plasma is indicated for the initial treatment of patients who are undergoing massive transfusion because of life-threatening trauma/hemorrhages and who have clinically significant coagulation deficiencies
- Do not use Liquid Plasma as the treatment for coagulation factor deficiencies where other products are available with higher factor concentrations

- Reference: Circular of Information for the Use of Human Blood and Blood Components, current edition

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Research

AAST 2012 Plenary Paper

Better hemostatic profiles of never-frozen liquid plasma compared with thawed fresh frozen plasma

Nena Matijevic, PharmD, PhD, Yao-Wei Wang, MD, Bryan A. Cotton, MD, MPH, Elizabeth Hartwell, MD, James M. Barbeau, MD, Charles E. Wade, PhD, and John B. Holcomb, MD, *New Orleans, Louisiana*

BLOOD COMPONENTS

Coagulation profile of liquid-state plasma

Robert C. Gosselin, Carol Marshall, Denis M. Duyre, Chris Gresens, Diana Davis, Lynette Scherer, and Douglas Taylor

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Mother Nature Gives Us a Great "Buffer"

- Coagulation factor levels usually exist at 100% activity or greater
- For individual factors, we have the ability to clot at much lower % activity levels

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FACTOR HALF LIVES

FACTOR	IN VIVO ½ LIFE	% NEEDED FOR HEMOSTASIS
I	3-6 DAYS	12 - 50
II	2-5 DAYS	10 - 25
V	5- 36 HOURS	10 - 30
VII	2 –5 HOURS	> 10
VIII	8 – 12 HOURS	30 - 40
IX	18 – 24 HOURS	15 - 40
X	20 - 42 HOURS	10 - 40
XI	40 – 80 HOURS	20 - 30
XIII	12 DAYS	< 5

From Technical Manual 17th edition Page 592

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Liquid Plasma (LP) Reimbursement

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Summary

- For patients with critical bleeding, early administration of Blood and Plasma components!
- Recent American College of Surgeons guidelines recommend immediate availability of plasma for balanced resuscitation (1:1:1 or 1:1:2 ratios of plasma, platelets, and red cells)
- Growing numbers of trauma centers are using Liquid Plasma as a "bridge" to a thawed plasma component such as FFP or PF24

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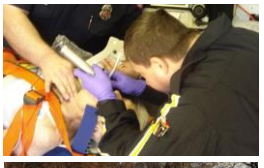
A Partnership to Save Lives

- Medical Center of Plano & PHI Air Medical have entered into a strategic partnership



- To bring the precious resource of blood and plasma to the patient at the point of injury

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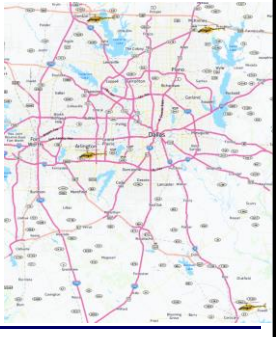
A Partnership to Save Lives

- 4 helicopter bases in North Texas
- Aircraft stocked with
  - Commercial tourniquets
  - Hemostatic dressings
  - Commercial pelvic binders
  - **2 units of packed red blood cells**
  - **2 units of liquid plasma**
  - 2 blood warmers
  - TXA



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Questions?

"Judge a man by his questions rather than his answers."

-Voltaire

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Thank you!

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