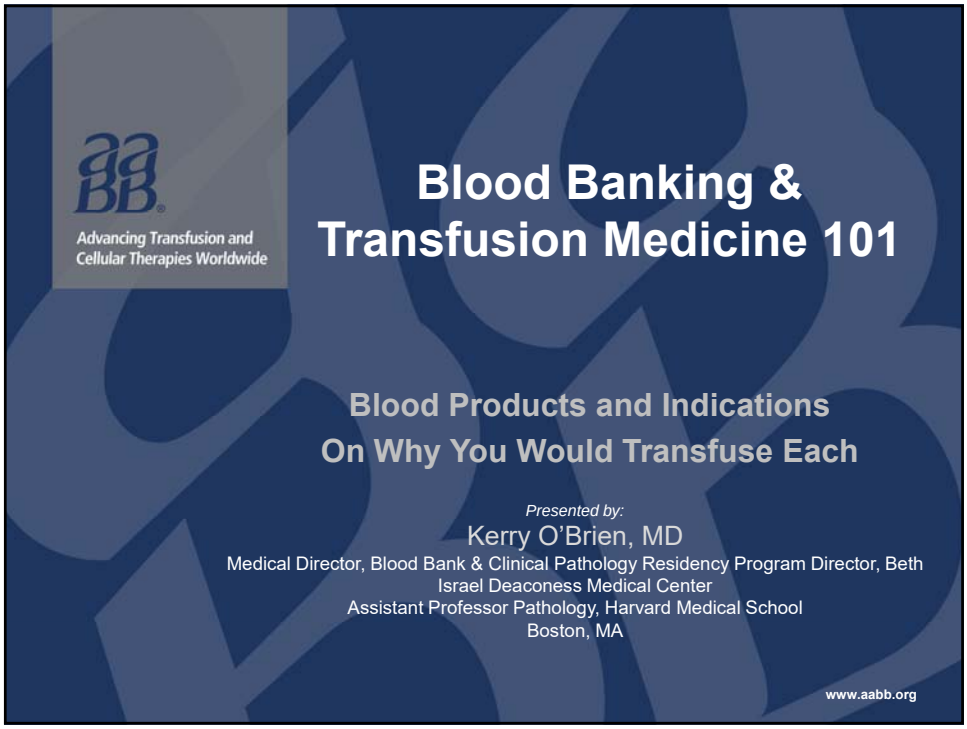



1

## Learning Objectives

After participating in this program you should be able to….

- Describe the main blood products available for transfusion in the United States.
  - Red blood cells
  - Plasma
  - Platelets
  - Cryoprecipitate
  - Whole blood (rarely used in the United States)
- Detail the indications for red blood cell transfusion.
  - To provide oxygenation
- Explain the indications for plasma transfusion.
  - To replace coagulation factors in a bleeding/coagulopathic patient
- Detail the indications for platelet transfusion.
  - To treat/prevent mucosal bleeding in patients with low platelet counts (thrombocytopenic patients)
- Describe the indications for cryoprecipitate transfusion.
  - Main indication is to replace fibrinogen in a bleeding/coagulopathic patient; cryoprecipitate also contains coagulation factors VIII (8) and XIII (13), von Willebrand factor, and fibronectin



2

## Case 1

- 80 year old woman presents to her primary care physician complaining of shortness of breath and heart palpitations
- Labs today:
  - Hemoglobin: 5.5 g/dL (Normal 13.5 – 17.5 g/dL)
  - Platelet count: 200,000/µL (Normal 150,000 – 400,000/µL)
  - Coagulation labs: INR 1.1, fibrinogen 200 mg/dL (Normals: INR 0.9 – 1.1; fibrinogen 180-400 mg/dL)
- Hemoglobin six months ago was 9.0 g/dL

www.aabb.org 3

3

- What blood product may help relieve the patient's symptoms?

www.aabb.org 4

4

## Case 2

- 67 year old man presents to his oncologist for follow-up for his acute myelogenous leukemia
- Since his visit last week, he complains of new tiny purple bruises along his legs and arms and some bleeding of his gums
- Labs show:
  - Hemoglobin: 8 g/dL (Normal 13.5 – 17.5 g/dL)
  - Platelet count: 9000/µL (Normal 150,000 – 400,000/µL)
  - Coagulation labs: INR 1.0, fibrinogen 250 mg/dL ((Normals: INR 0.9 – 1.1; fibrinogen 180-400 mg/dL)

www.aabb.org 5

5

- What blood product may help relieve the patient's symptoms?

www.aabb.org 6

6

## Case 3

- A 23 year old man is brought to the emergency room after being hit by a car while riding his bicycle
- He has significant abdominal trauma and is being urgently brought to the operating room
- Labs show:
  - Hemoglobin: 8 g/dL (Normal 13.5 – 17.5 g/dL)
  - Platelet count: 100,000/µL (Normal 150,000 – 400,000/µL)
  - Coagulation labs: INR 2.0, fibrinogen < 100 mg/dL (Normals: INR 0.9 – 1.1; fibrinogen 180-400 mg/dL)

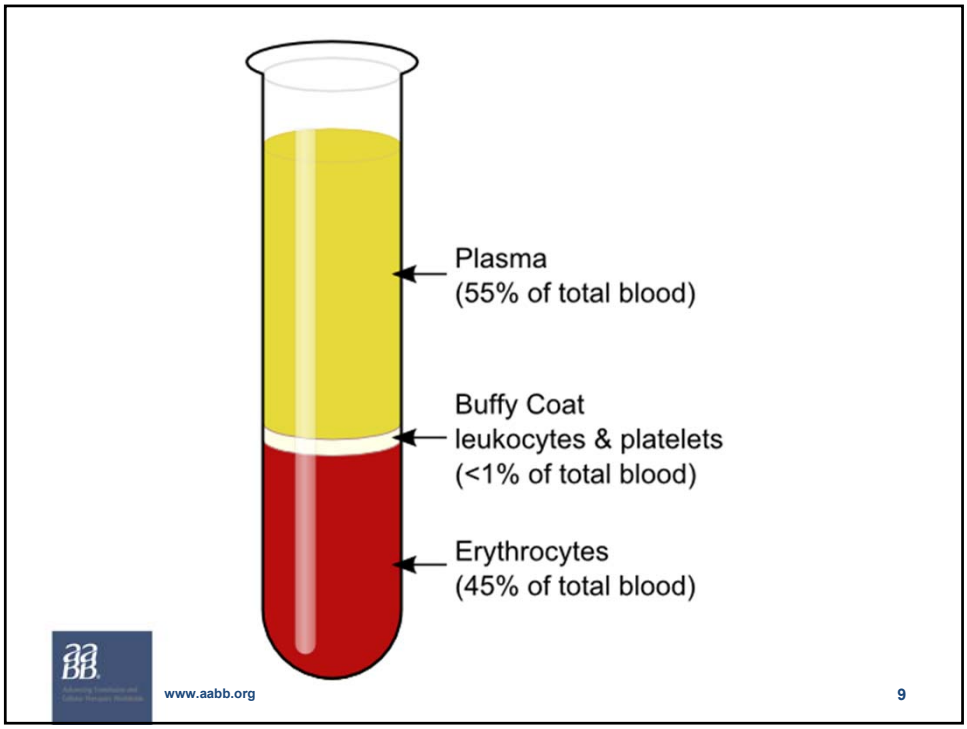
www.aabb.org 7

7

- What blood products may help relieve the patient's symptoms?

www.aabb.org 8

8




9


***Whole Blood***

Donor blood.....450cc
Red cells.....200cc

Plasma.....250cc

Platelets.....1 “unit”

Anticoagulant (CPDA-1).....63cc

10

## Via whole blood donation or apheresis

- Red blood cells
- Plasma
- Platelets
- Cryoprecipitate

www.aabb.org 11

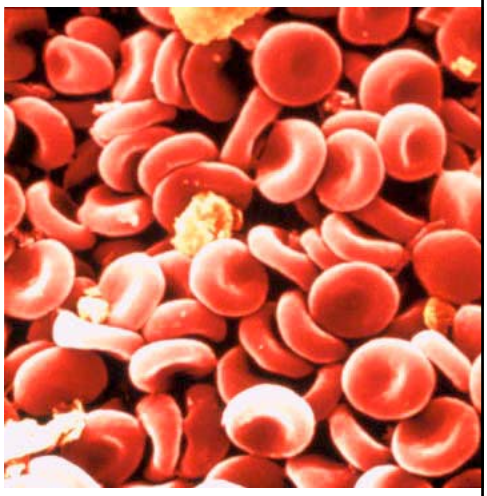
11

## The Family


www.aabb.org 12

12

# Red Blood Cells



www.aabb.org 13

13

# Red Blood Cells (RBCs)

- Refrigerator (1-6$^0$C)
- 42 days


14

## When should RBCs be transfused?

- To increase oxygen-carrying capacity in patients with anemia in whom physiologic compensatory mechanisms are inadequate to maintain normal tissue oxygenation
- As a source of replacement red blood cells during red blood cell exchange
  - Examples: patients with sickle cell anemia, malaria, babesiosis


www.aabb.org

*Kaufman RM, Shehata N. (2017). 'Hemotherapy decisions and their outcomes'. In: Fung MK et al (eds.) Technical Manual, 19th ed. AABB:Bethesda, pp.505-507.* 15

15

## What are concerning signs of anemia?

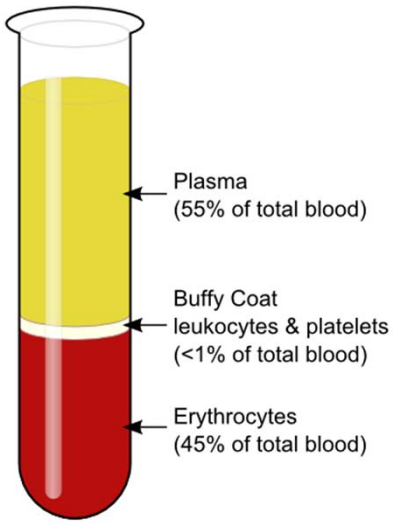
- Hemodynamic instability (shock)
- Chest pain (cardiac-type)
- Shortness of breath
- Tachycardia (increased pulse) at rest

www.aabb.org

*Kaufman RM, Shehata N. (2017). 'Hemotherapy decisions and their outcomes'. In: Fung MK et al (eds.) Technical Manual, 19th ed. AABB:Bethesda, pp.505-507.* 16

16

## Plasma

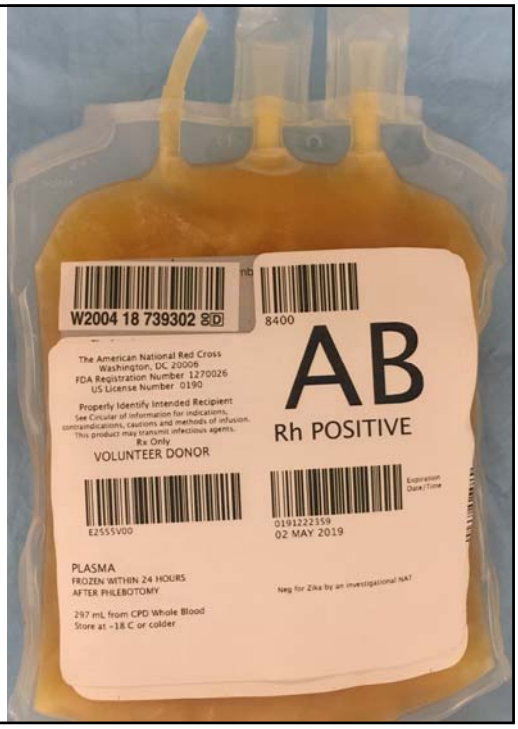



www.aabb.org 17

17

## Plasma

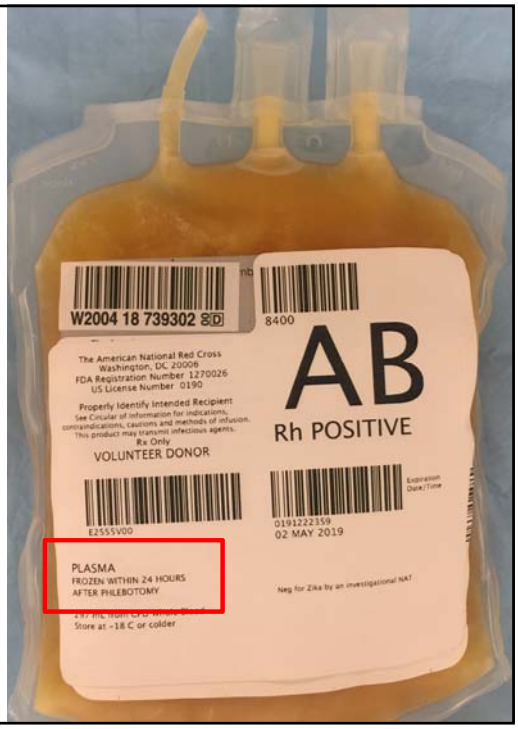
- Stored frozen for up to 1 year
- 5 days at 1-6ºC once thawed




18

## Plasma

- FFP
- PF24
- Thawed plasma
- Solvent/detergent treated plasma




19

## But which is the best?

- FFP: fresh frozen plasma = plasma frozen within 8 hours of phlebotomy
- PF24 = plasma frozen within 24 hours after phlebotomy
- TP: thawed plasma = one of the above that was thawed and refrigerated at 1-6ºC for up to 5 days post-thaw

www.aabb.org

*Kaufman RM, Shehata N. (2017). 'Hemotherapy decisions and their outcomes'. In: Fung MK et al (eds.) Technical Manual, 19th ed. AABB:Bethesda, pp.516-518*

20

20

## But which is the best?

- SD plasma – solvent detergent treated plasma = Pooled from many donors of the same ABO type and treated with pathogen inactivation methods
- In the USA, available from Octapharma as Octaplas®, Pooled Plasma (Human), Solvent/Detergent Treated Solution for Intravenous Infusion.


www.aabb.org

*Kaufman RM, Shehata N. (2017). 'Hemotherapy decisions and their outcomes'. In: Fung MK et al (eds.) Technical Manual, 19th ed. AABB:Bethesda, pp.516-518.*

21

21

## When should plasma be transfused?

- To treat bleeding in patient with multiple coagulation factor deficiencies
- To treat and prevent bleeding in patients with specific plasma protein deficiencies for which a specific factor concentrate does not exist
- In massive transfusion protocols with other blood products
- To reverse anticoagulation effects of warfarin

www.aabb.org

*Kaufman RM, Shehata N. (2017). 'Hemotherapy decisions and their outcomes'. In: Fung MK et al (eds.) Technical Manual, 19th ed. AABB:Bethesda, pp.516-518.*

22

22

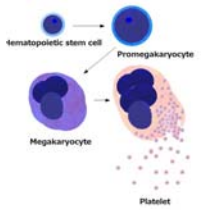
## Platelets



- *5 days from time of donation*
- *Stored at 20-24C with agitation*

23

## What are platelets?




- Anuclear cells produced by bone marrow
- Survive for ~ 10 days once released from the bone marrow
- Smaller than a red blood cell
- Normal platelet count in a healthy adult is between 150,000 and 400,000/μL
- People make on average 35,000 to 44,000 platelets/μL per day

www.aabb.org

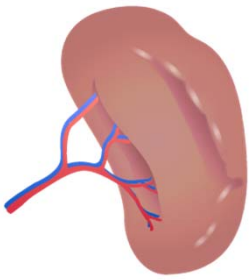
*Kaufman RM, Shehata N. (2017). 'Hemotherapy decisions and their outcomes'. In: Fung MK et al (eds.) Technical Manual, 19th ed. AABB:Bethesda, pp.516-518*

24

24

## What do platelets do?

- 2/3 are in the general circulation
- 1/3 are in the spleen
- Vital to cell-based hemostasis (clotting)

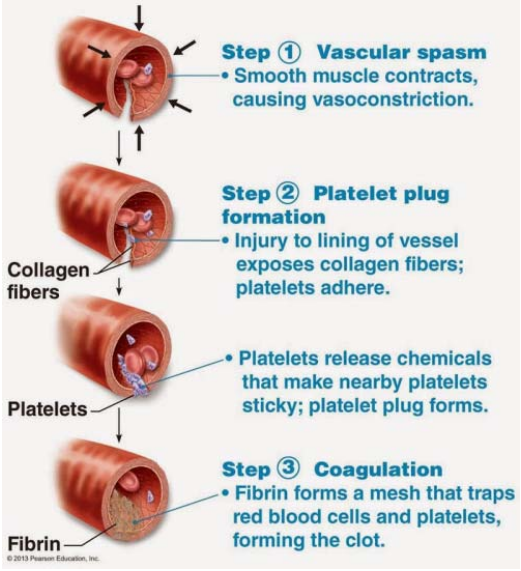


www.aabb.org

25

25

## Clotting




www.aabb.org

26

26

## When should platelets be transfused?

- To prevent bleeding in patients with thrombocytopenia from chemotherapy
- To prevent bleeding prior to invasive procedures (not good evidence at all)
- To treat active bleeding along with other blood products

www.aabb.org

*Kaufman RM, Shehata N. (2017). 'Hemotherapy decisions and their outcomes'. In: Fung MK et al (eds.) Technical Manual, 19th ed. AABB:Bethesda, pp.511-514.*[27]

27

## Cryoprecipitate (aka Cryo)

- Stored frozen for a year
- Once thawed, store 20-24ºC for 6 hours


28

## What does cryo have?

- Derived from plasma
- Contains fibrinogen, Factor VIII, Factor XIII, von Willebrand Factor and fibronectin

www.aabb.org

*Kaufman RM, Shehata N. (2017). 'Hemotherapy decisions and their outcomes'. In: Fung MK et al (eds.) Technical Manual, 19th ed. AABB:Bethesda, pp.518-519.* 29

29

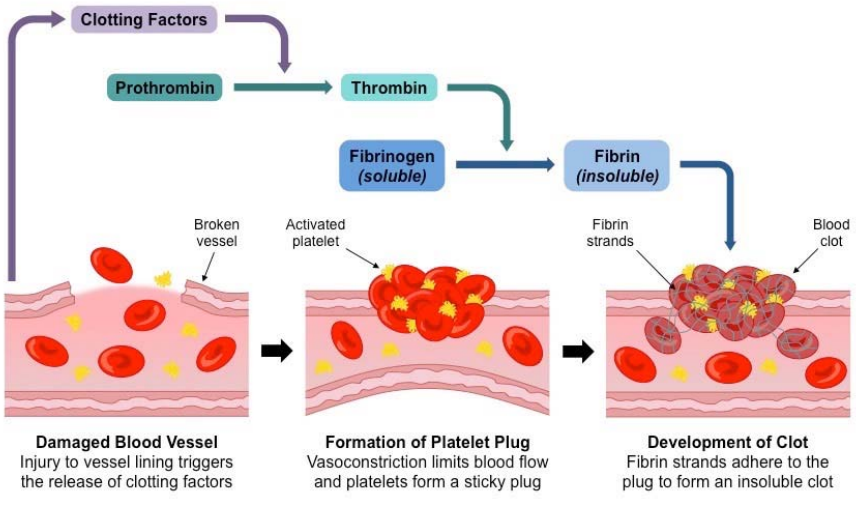
## When should cryo be transfused?

- To replace fibrinogen in patients with acquired hypofibrinogenemia who are bleeding or having an invasive procedure
- Given to adults as a pool(s) from 10 total donors
  - 1 dose will raise fibrinogen level by 75-100 mg/dL

www.aabb.org

*Kaufman RM, Shehata N. (2017). 'Hemotherapy decisions and their outcomes'. In: Fung MK et al (eds.) Technical Manual, 19th ed. AABB:Bethesda, pp.511-514.* 30

30




www.aabb.org

https://ib.bioninja.com.au/standard-level/topic-6-human-physiology/63-defence-against-infectio/clotting.html

31

31

## Additional products your Blood Bank may have

- HLA matched platelets
- Granulocytes
- Factor concentrates – human and recombinant
  - rFVIIa
  - Kcentra
  - Recombinant FVIII and FIX
  - Humate
  - Thrombate
  - Rh immune globulin
  - Fibrinogen concentrate
- Intravenous immune globulin (IVIG)

32

## Fibrinogen concentrate


- Human plasma derived product intended for fibrinogen replacement
- Only FDA approved for treatment of bleeding in patients with congenital fibrinogen deficiency
- Dosing is based on fibrinogen level and patient weight
- More expensive than cryoprecipitate
- Not available at all hospitals

33

## Back to the cases



34

## Case 1

- 80 year old woman presents to her primary care physician complaining of shortness of breath and heart palpitations
- Labs today:
  - Hemoglobin: 5.5 g/dL (Normal 13.5 – 17.5 g/dL)
  - Platelet count: 200,000/µL (Normal 150,000 – 400,000/µL)
  - Coagulation labs: INR 1.1, fibrinogen 200 mg/dL (Normals: INR 0.9 – 1.1; fibrinogen 180-400 mg/dL)
- Hemoglobin six months ago was 9.0 g/dL

www.aabb.org 35

35

- What blood product may help relieve the patient's symptoms?
  - Packed red blood cells

www.aabb.org 36

36

## Case 2

- 67 year old man presents to his oncologist for follow-up for his acute myelogenous leukemia
- Since his visit last week, he complains of new tiny purple bruises along his legs and arms and some bleeding of his gums
- Labs show:
  - Hemoglobin: 8 g/dL (Normal 13.5 – 17.5 g/dL)
  - Platelet count: 9000/µL (Normal 150,000 – 400,000/µL)
  - Coagulation labs: INR 1.0, fibrinogen 250 mg/dL ((Normals: INR 0.9 – 1.1; fibrinogen 180-400 mg/dL)

www.aabb.org 37

37

- What blood product may help relieve the patient's symptoms?
  - Platelets

www.aabb.org 38

38

## Case 3

- A 23 year old man is brought to the emergency room after being hit by a car while riding his bicycle
- He has significant abdominal trauma and is being urgently brought to the operating room
- Labs show:
  - Hemoglobin: 8 g/dL (Normal 13.5 – 17.5 g/dL)
  - Platelet count: 100,000/µL (Normal 150,000 – 400,000/µL)
  - Coagulation labs: INR 2.0, fibrinogen < 100 mg/dL (Normals: INR 0.9 – 1.1; fibrinogen 180-400 mg/dL)



39

- What blood product may help relieve the patient's symptoms?
  - Packed red blood cells
  - Plasma
  - Platelets
  - Cryoprecipitate



40

## You've made it to the end……

www.aabb.org

41

41

## Final Thoughts

- Describe the products available for transfusion in the US
  - Red blood cells
  - Plasma
  - Platelets
  - Cryoprecipitate
- Detail indications for each blood product
- Discuss the conclusion of each presented clinical case

42

## Questions?

Contact
AABB eLearning Team
eLearning@aabb.org





43