Transfusion Medicine

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Transfusion Medicine Outline

- Blood groups
  - Introduction
  - ABO system
  - Rh system
  - Other systems
- Blood transfusion
  - Blood products
  - Testing
  - Dangers

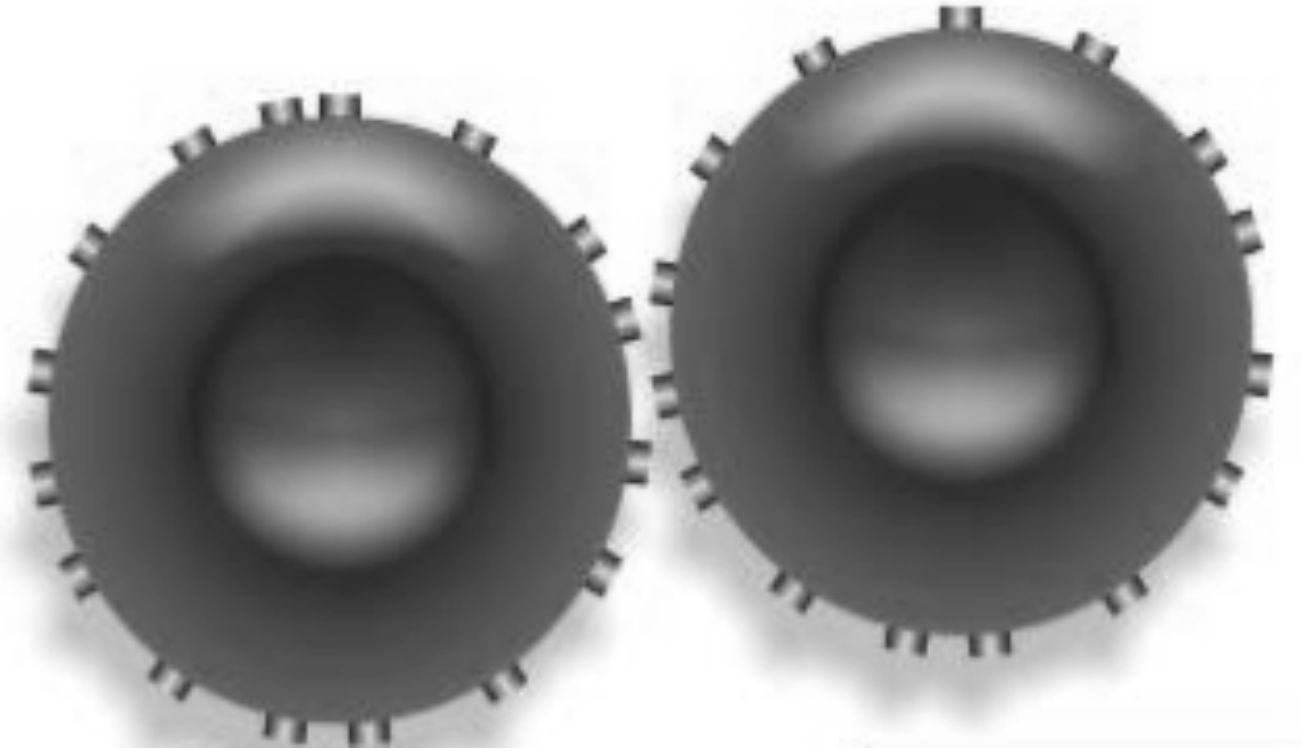
Transfusion Medicine Outline

- Blood groups
  - Introduction

Q. What determines a blood group?

Q. What determines a blood group?

A. The antigens on the red cell surface.



Red Cell Antigens

- Antigens are inherited (Mendelian pattern)
- Real function unknown
- Damn important during transfusion
- Lots of antigens exist (grouped into systems)
- Most important systems: ABO and Rh

Transfusion Medicine Outline

- Blood groups
  - Introduction
  - ABO system

What are the antigens?

- A and B
- Some people have A antigen (“type A”)
- Some people have B antigen (“type B”)
- Some people have both A and B (“type AB”)
- Some people have neither A nor B (“type O”)

Type A

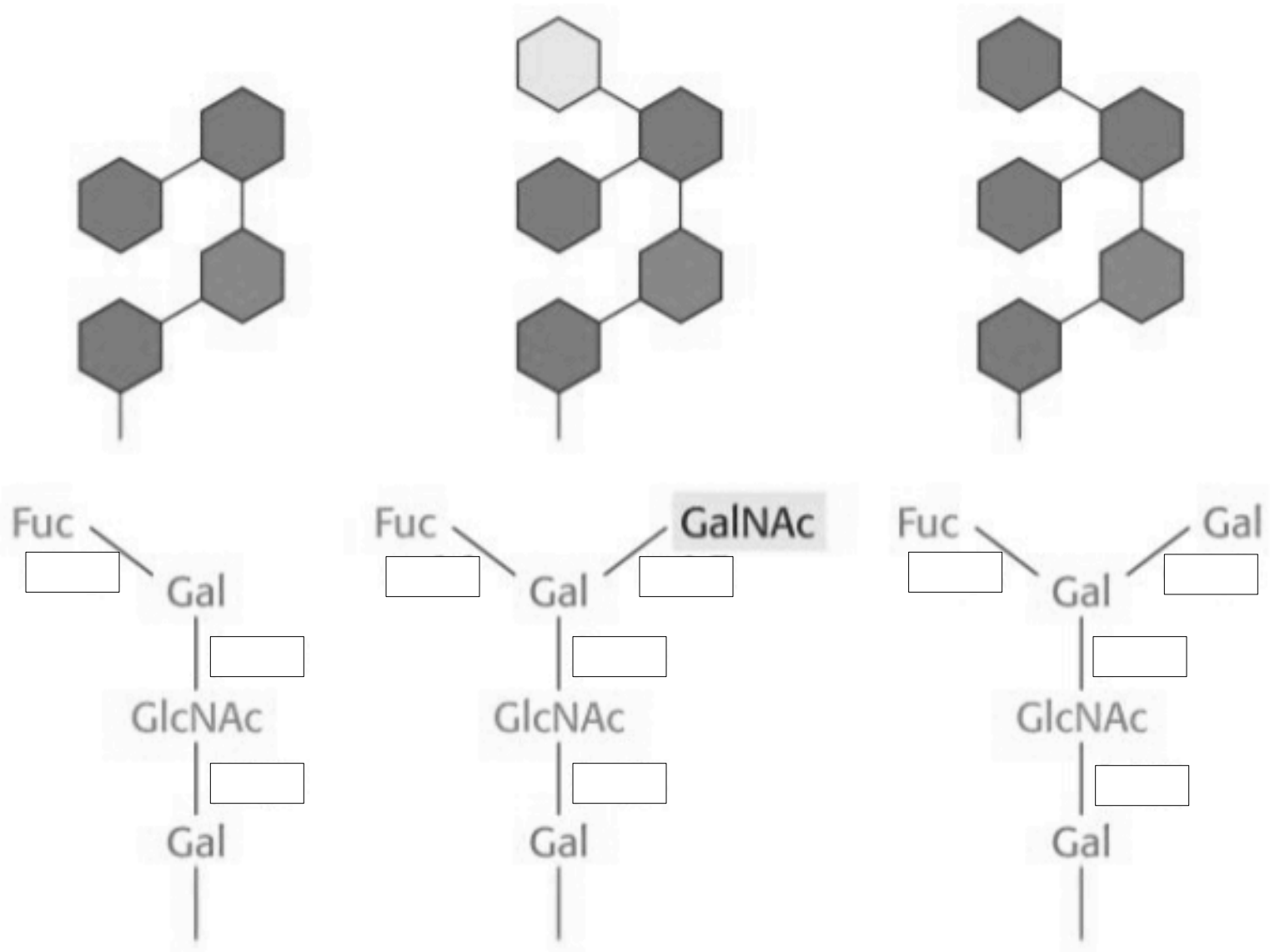
Type B

Type AB

Type O

How do you make the antigens?

- Start with a protein precursor
- Add fucose to make H antigen
- Add N-acetylgalactosamine to H Ag to make A Ag
- Add galactose to H Ag to make B Ag



H antigen A antigen B antigen

What are the genes?

H gene

- Everyone* has this one
- Codes for an enzyme that makes H antigen

A, B, and O genes

- Everyone has two genes
- Six possible genotypes: AA, BB, AB, AO, BO, OO
- A and B code for enzymes that make A and B antigens
- O has no gene product.*

* Almost

Genotype	Antigens	Blood type
AA	A	A
AO		
BB	B	B
BO		
AB	A and B	AB
OO	None	O

How common is each blood type?

Blood type	Percent of population
A	40%
B	12%
AB	6%
O	42%

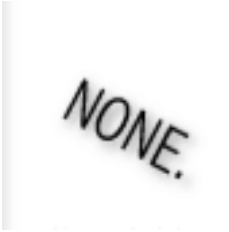
So what?

- We have antibodies to the antigens we don't have!
- Anti-A antibodies lyse type A red cells.
- Anti-B antibodies lyse type B red cells.
- This is very important during blood transfusion.

Type A

Type B

Type AB



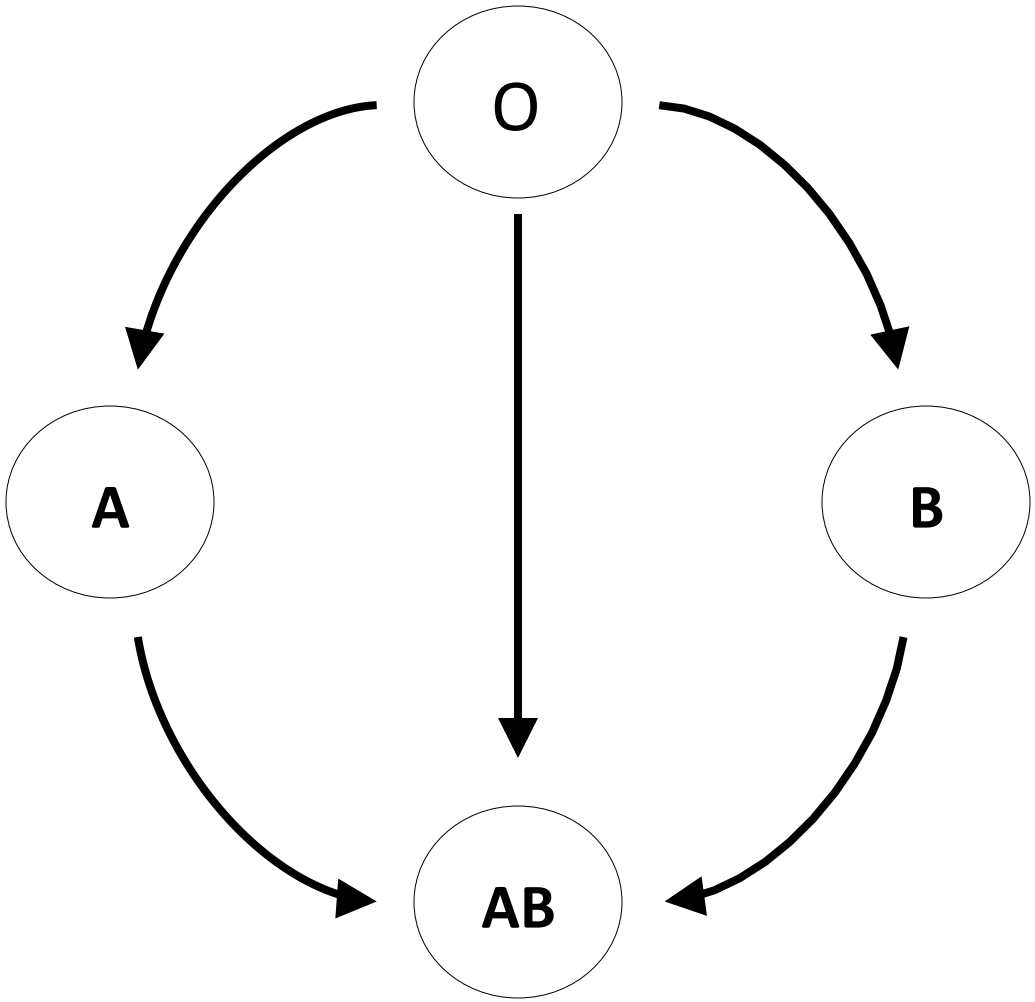
Type O

Genotype	Antigens	Blood type	Antibodies
AA	A	A	anti-B
AO			
BB	B	B	anti-A
BO			
AB	A and B	AB	none
OO	None	O	anti-A anti-B

Compatible blood types

Recipient blood type	Donor blood type
A	A or O*
B	B or O
AB	AB, A, B, or O
O	O

* type O = universal dOnor!


O
A
B
AB

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  - ABO system
  - Rh system

What are the antigens?

- Most important antigen: D!
- "Rh" because discovered using Rhesus monkeys.
- "Rh factor" refers to the D antigen.
- Two alleles: D and d.
- People with the D allele make D antigen and are Rh+.

Genotype	Antigens	Blood type
DD	D	Rh +
Dd	D	Rh +
dd	none	Rh -

What are the antibodies?

- Antibodies in this system are acquired!
- To make anti-D you must:
  1. lack the D antigen on your red cells
  2. get exposed to D + blood
- Donor and recipient are tested for the D antigen.

Transfusion Medicine Outline

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  - Other systems

Don’t tell me there are more systems.

- There are a almost a sh*tload of other systems.*
- These are not included in routine testing.
- Antibodies to antigens in these systems are usually acquired (like anti-D), so unless a patient has been transfused or pregnant, you don’t need to worry too much.

* Not quite: a sh*tload is defined as more than 42.

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What do you mean, products?

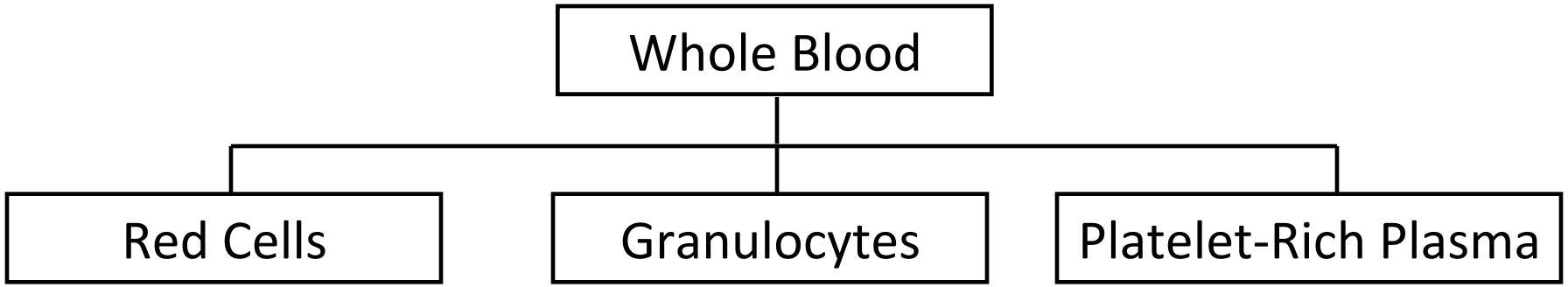
- In olden times, there was only whole blood.
- Now, we separate blood into its components
- Better for the patient
- Conserves blood supply

What are the products?

- Whole blood
- Red cells
- Platelets
- Granulocytes
- Cryoprecipitate
- Fresh frozen plasma

Apheresis donation

BLOOD PRODUCTS



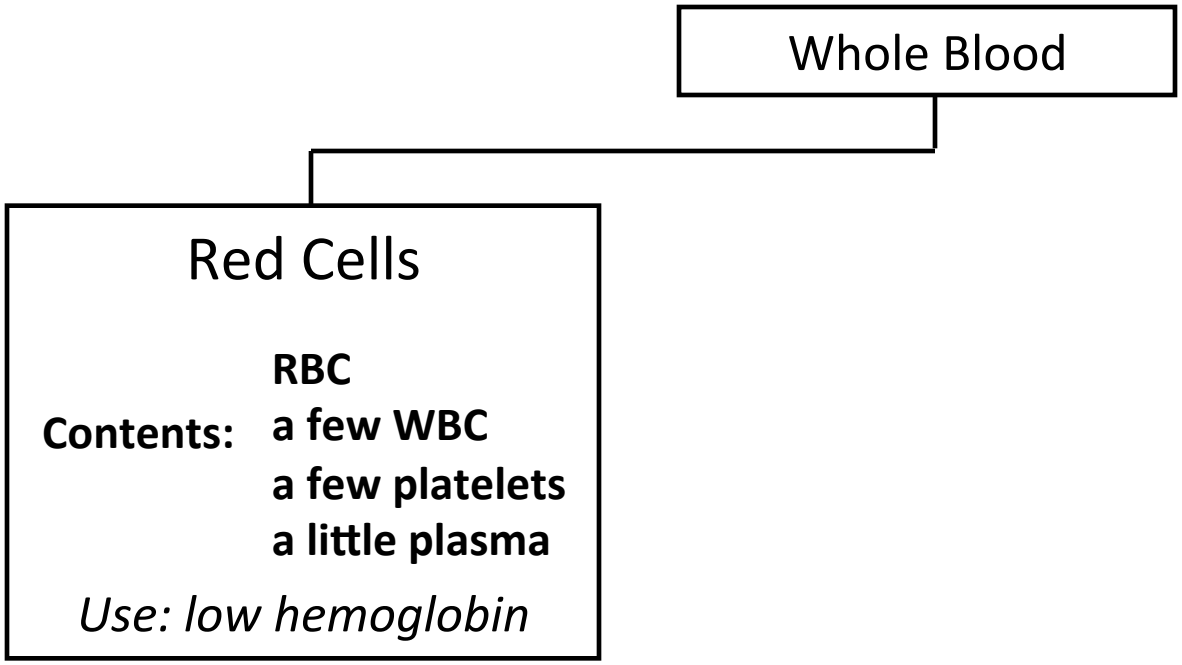
BLOOD PRODUCTS

Whole Blood

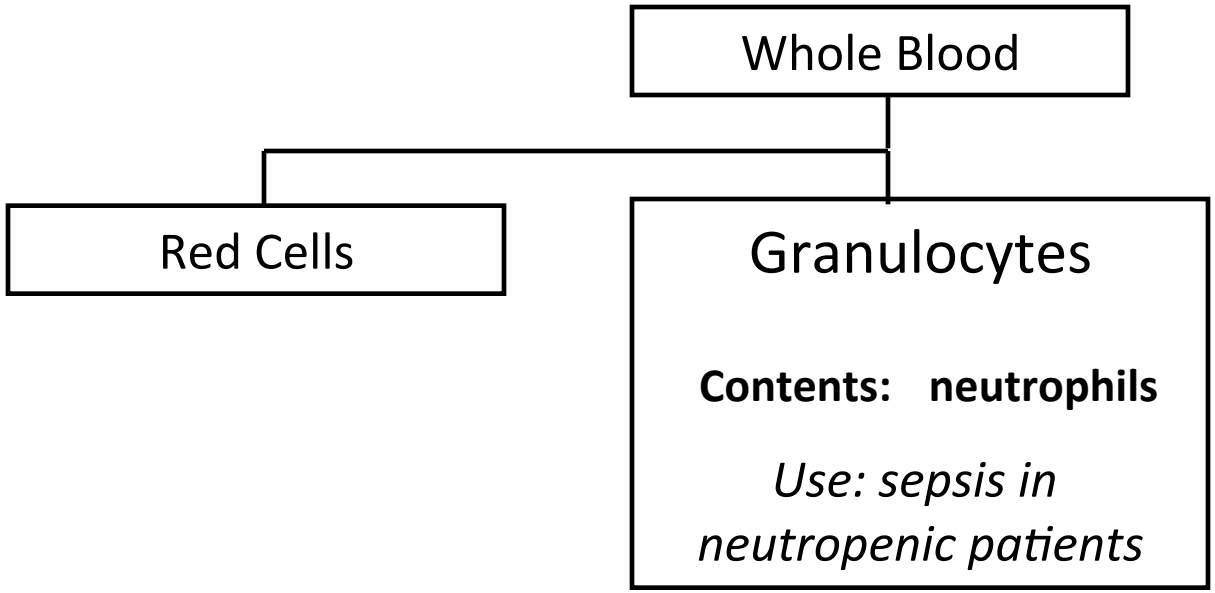
Contents:
- **RBC**
- **WBC**
- **platelets**
- **plasma**

Use: massive hemorrhage

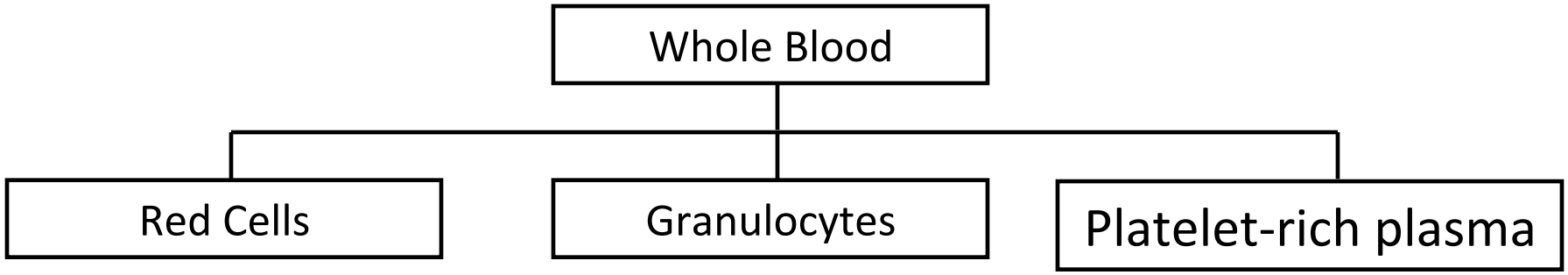
BLOOD PRODUCTS



BLOOD PRODUCTS



BLOOD PRODUCTS



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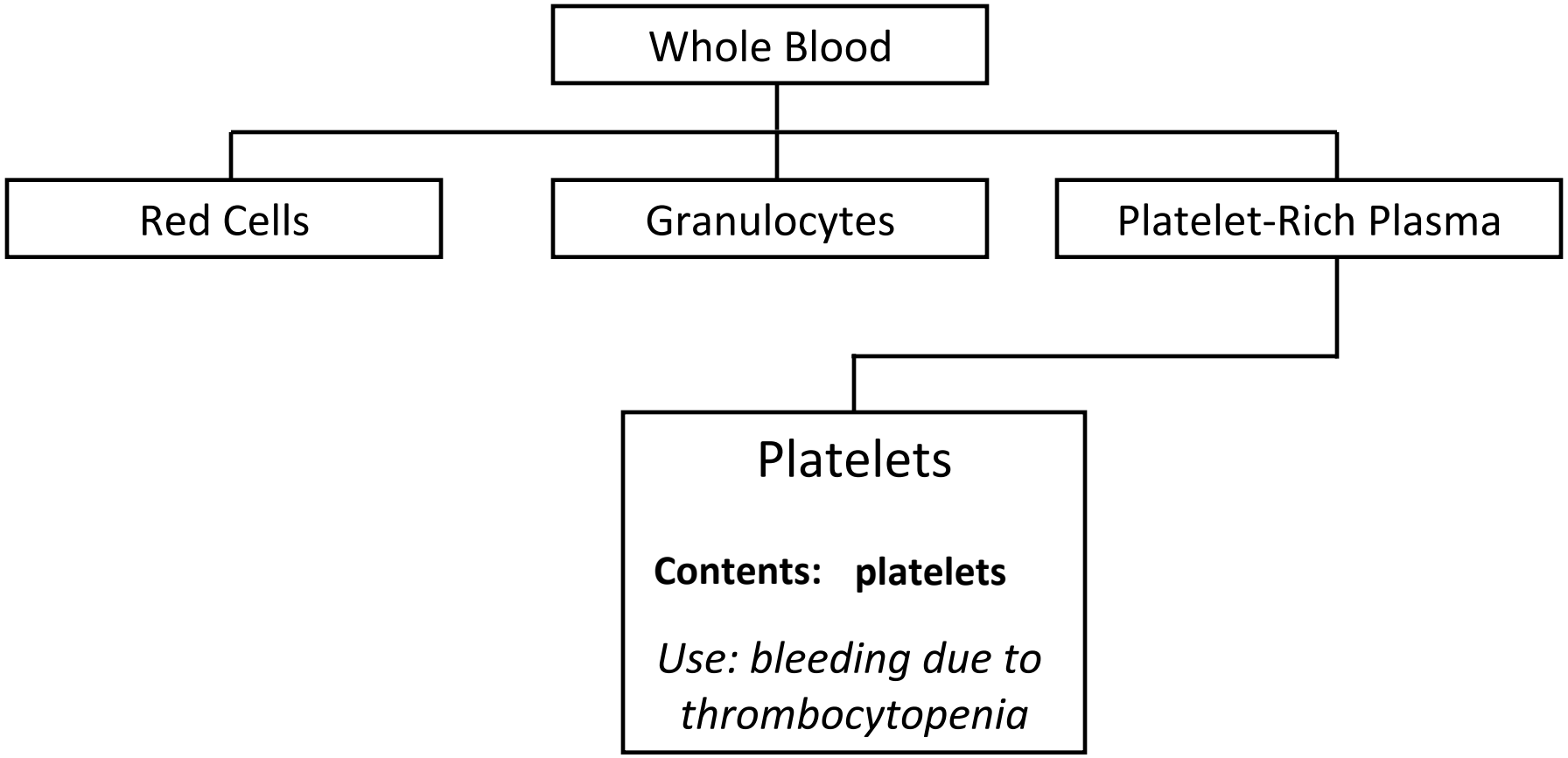

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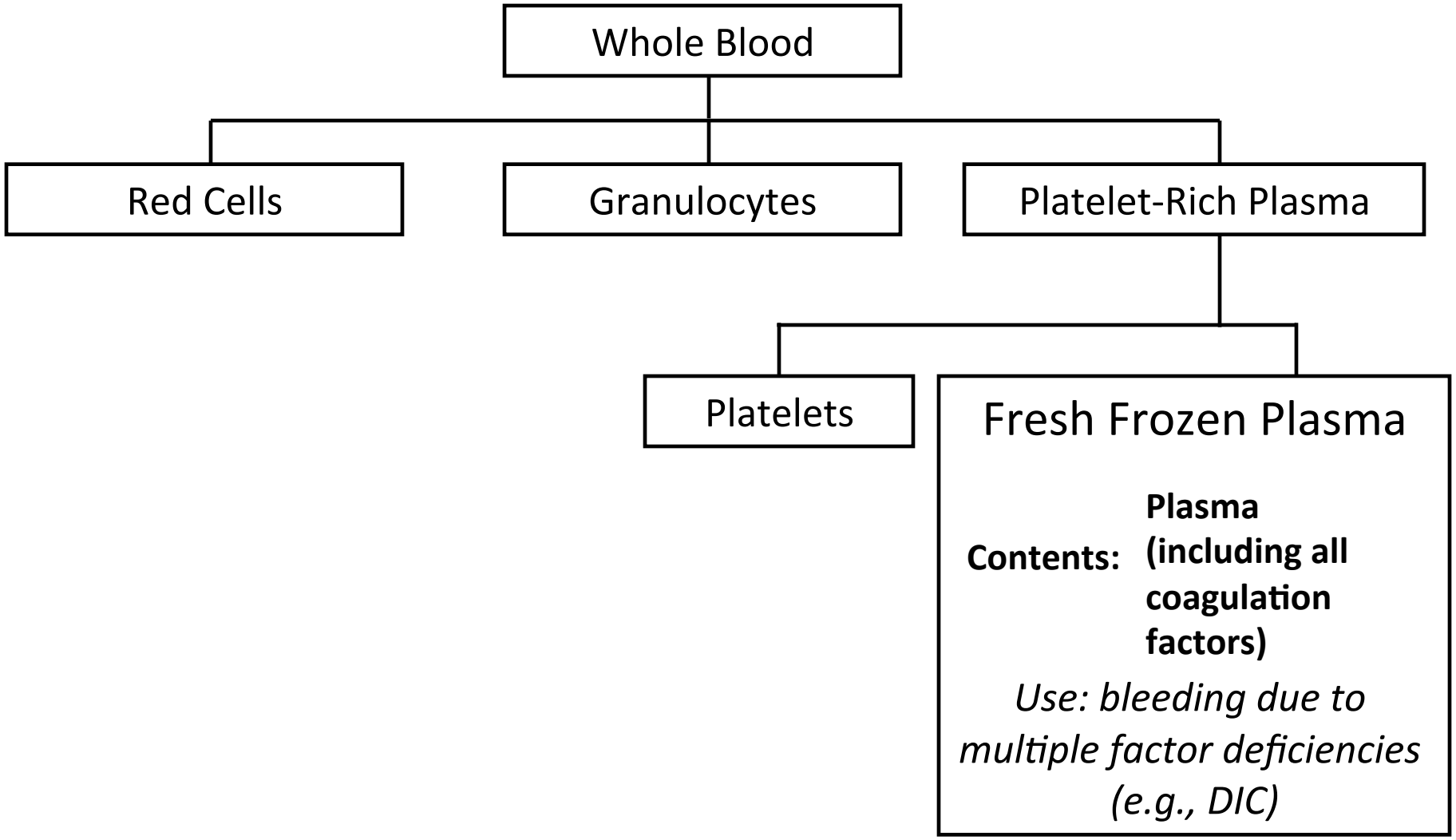

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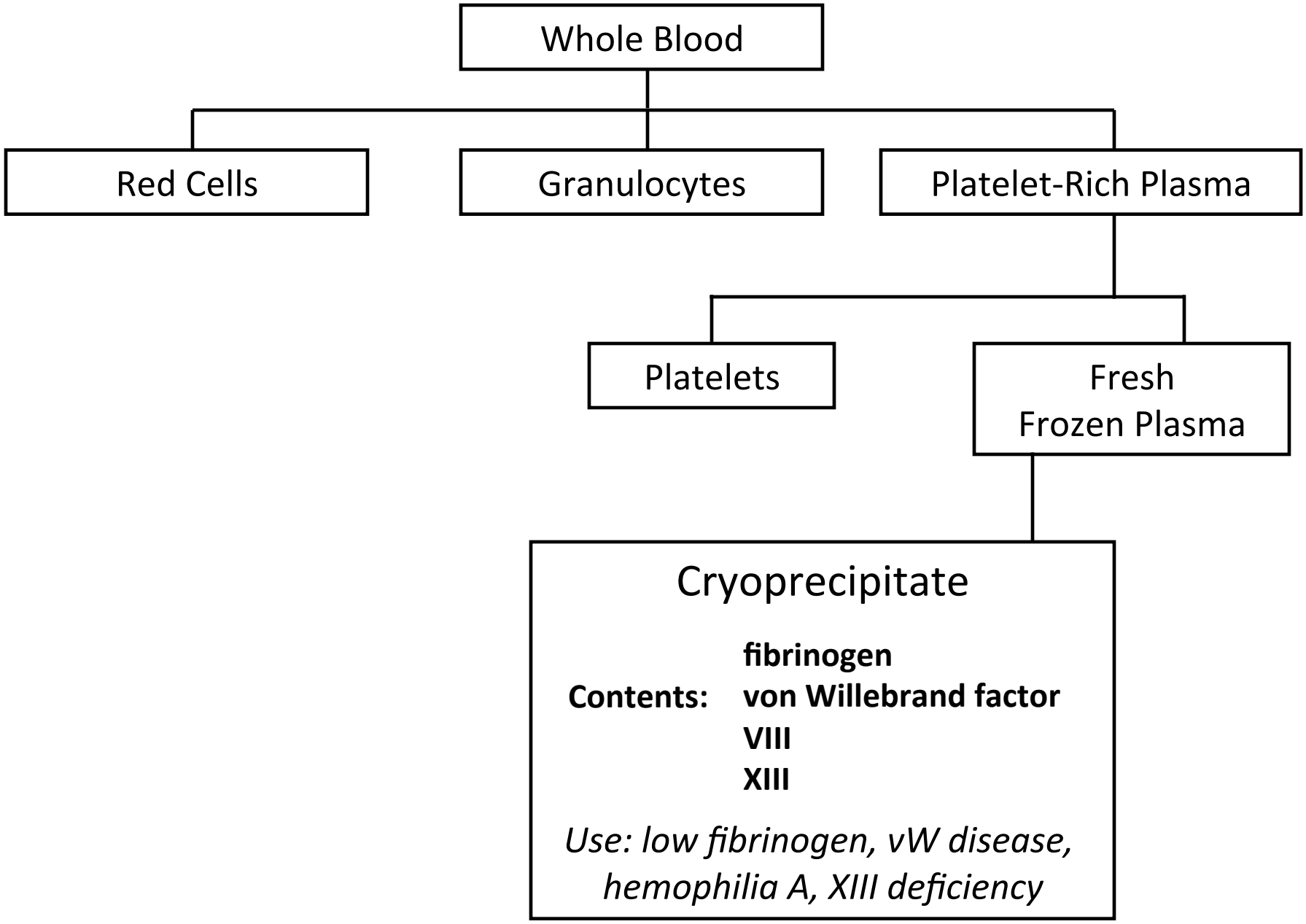

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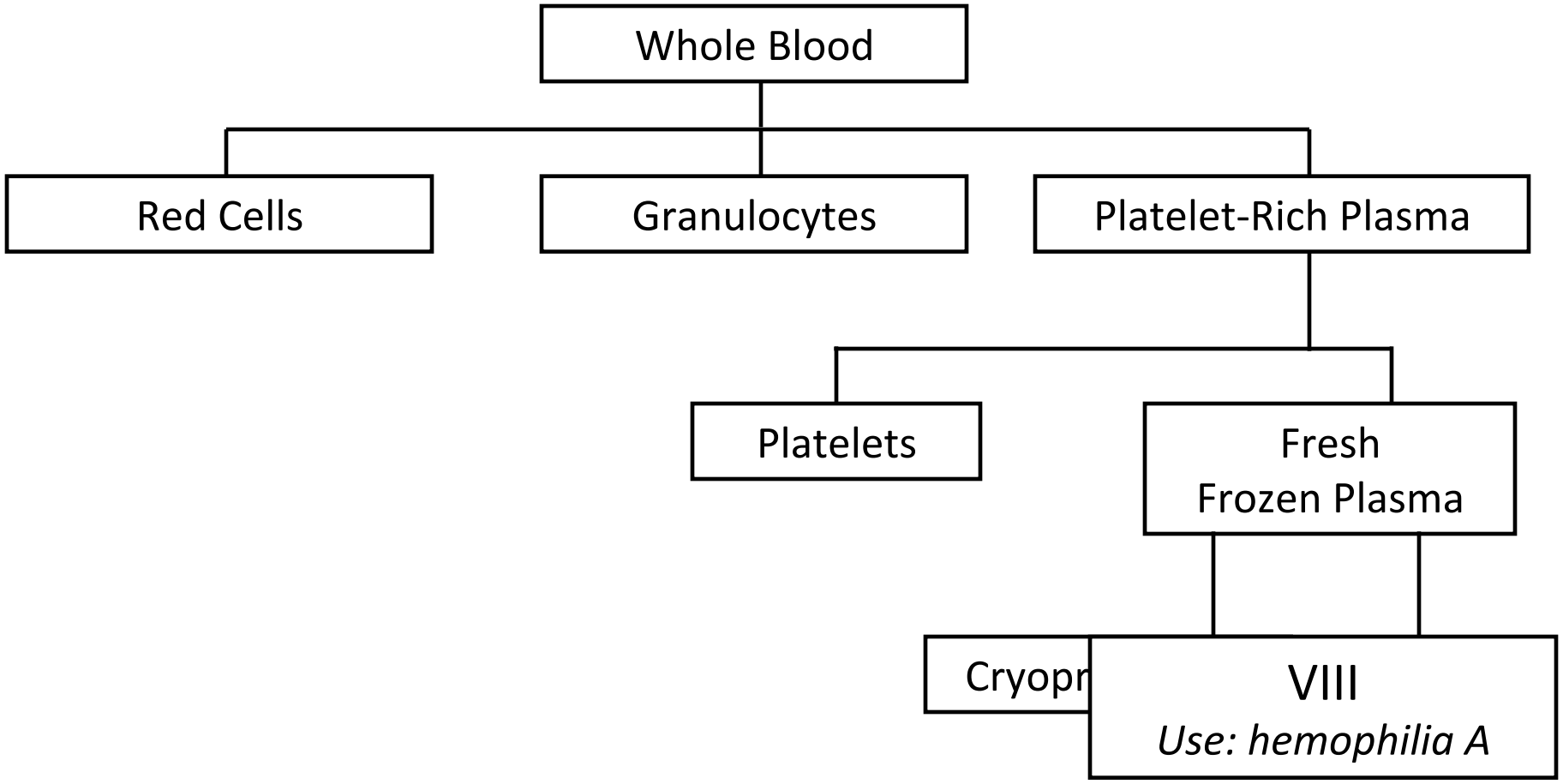

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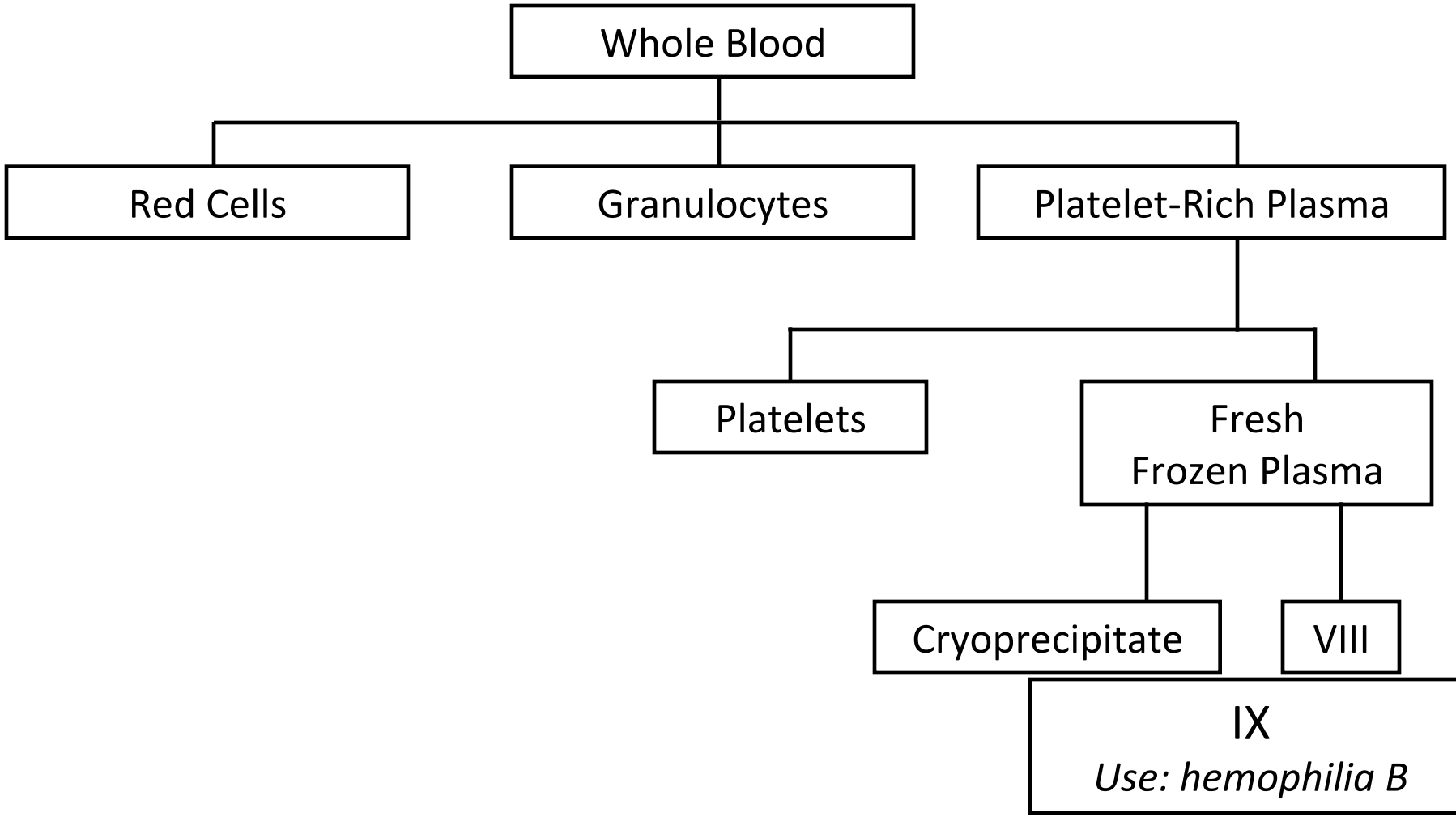

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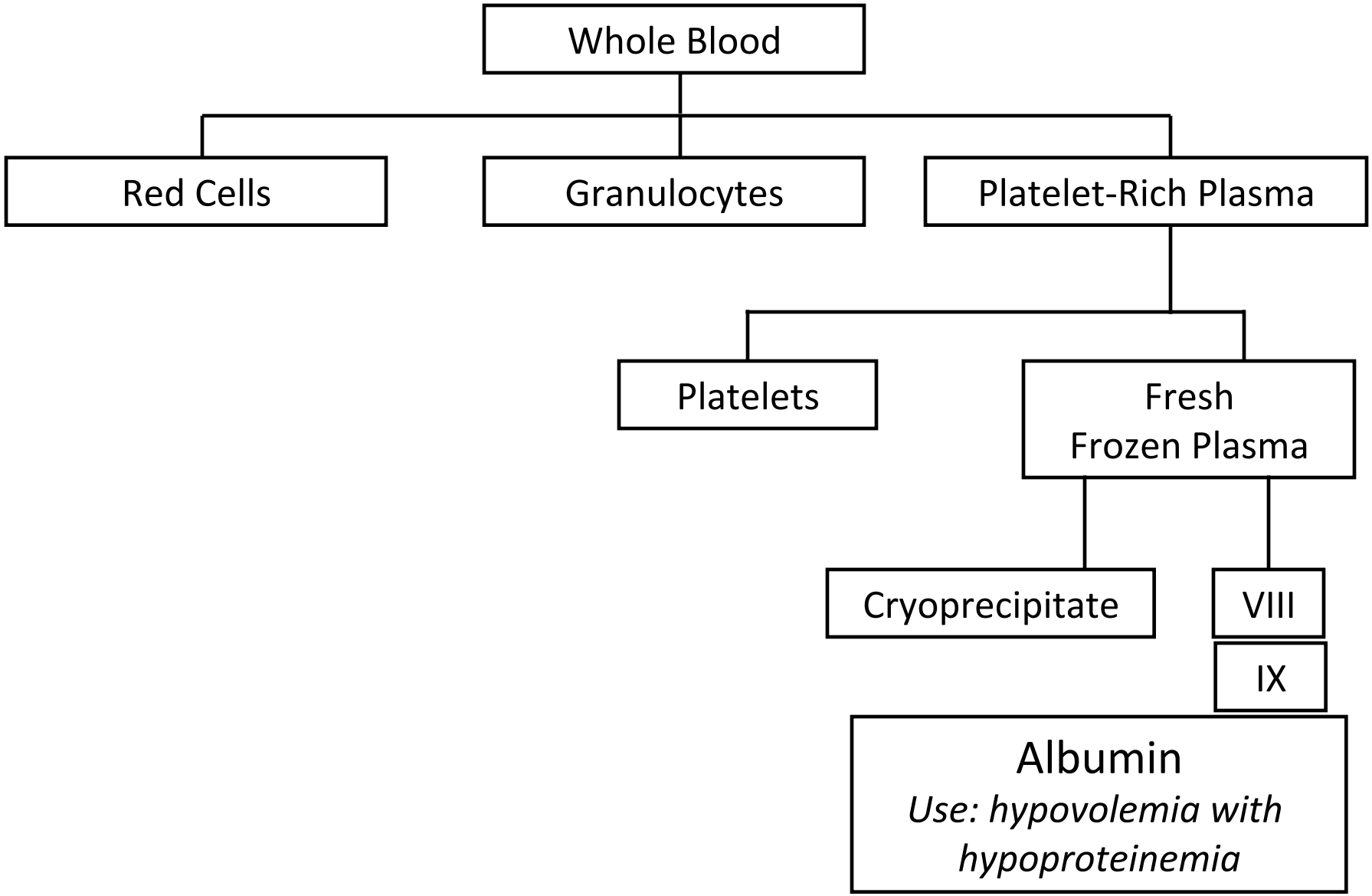

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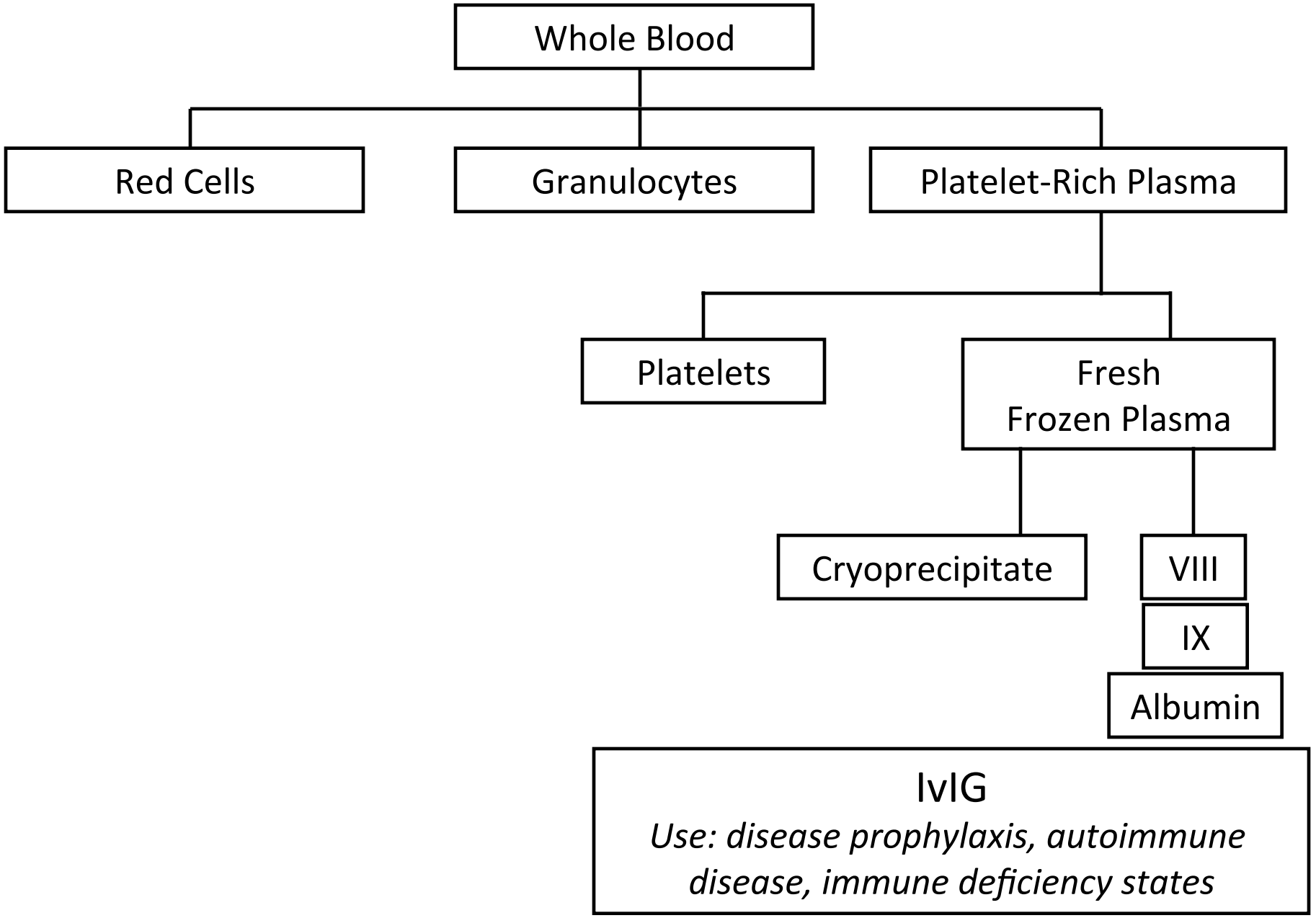

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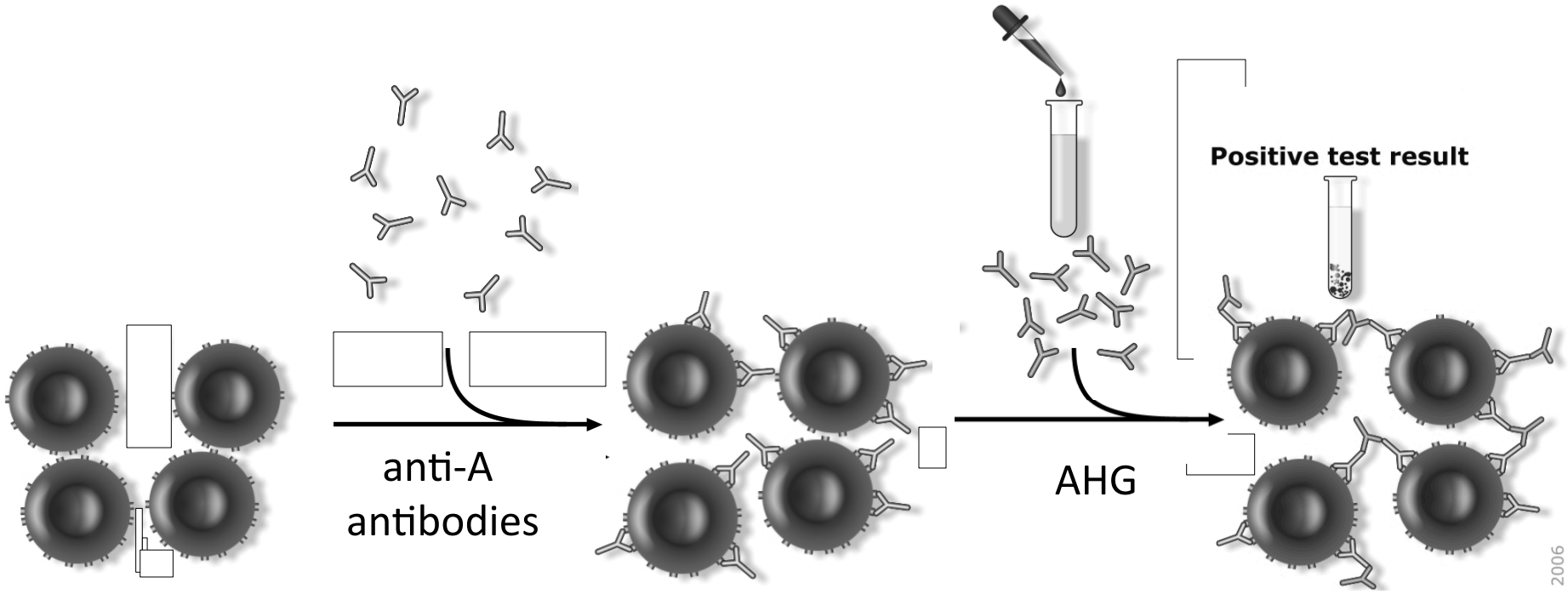
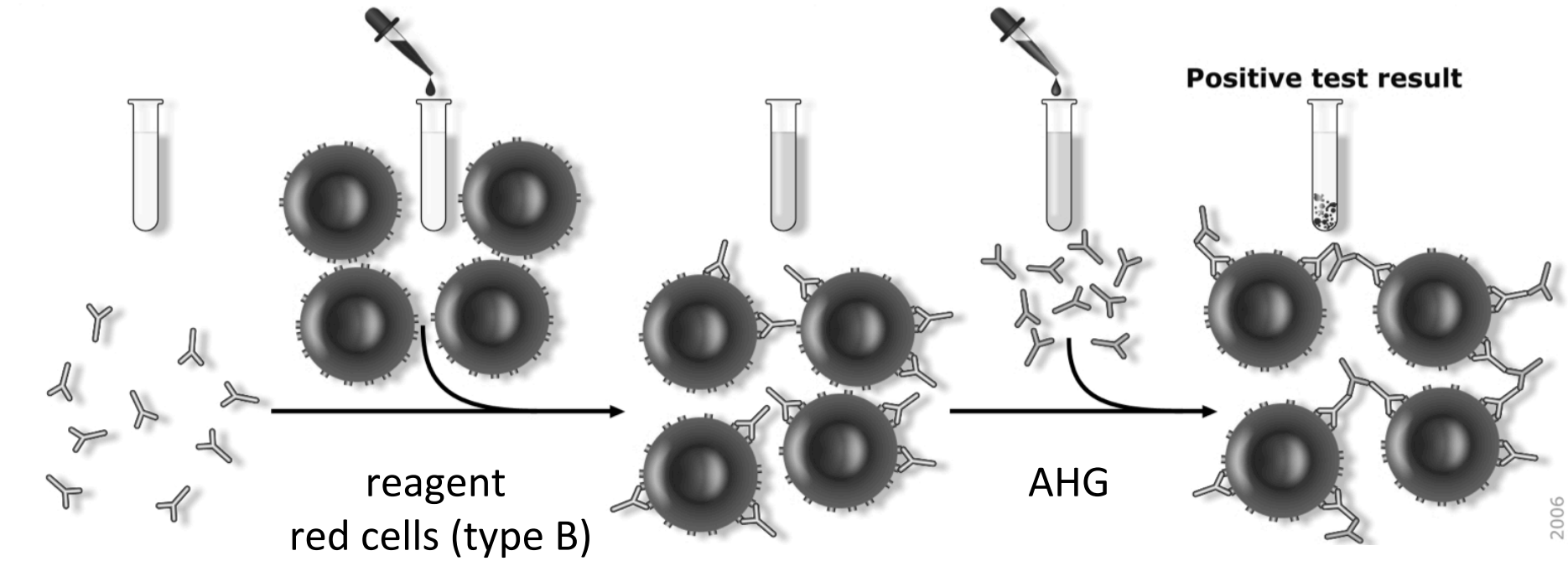
FORWARD TYPE



patient
red cells
(type A)

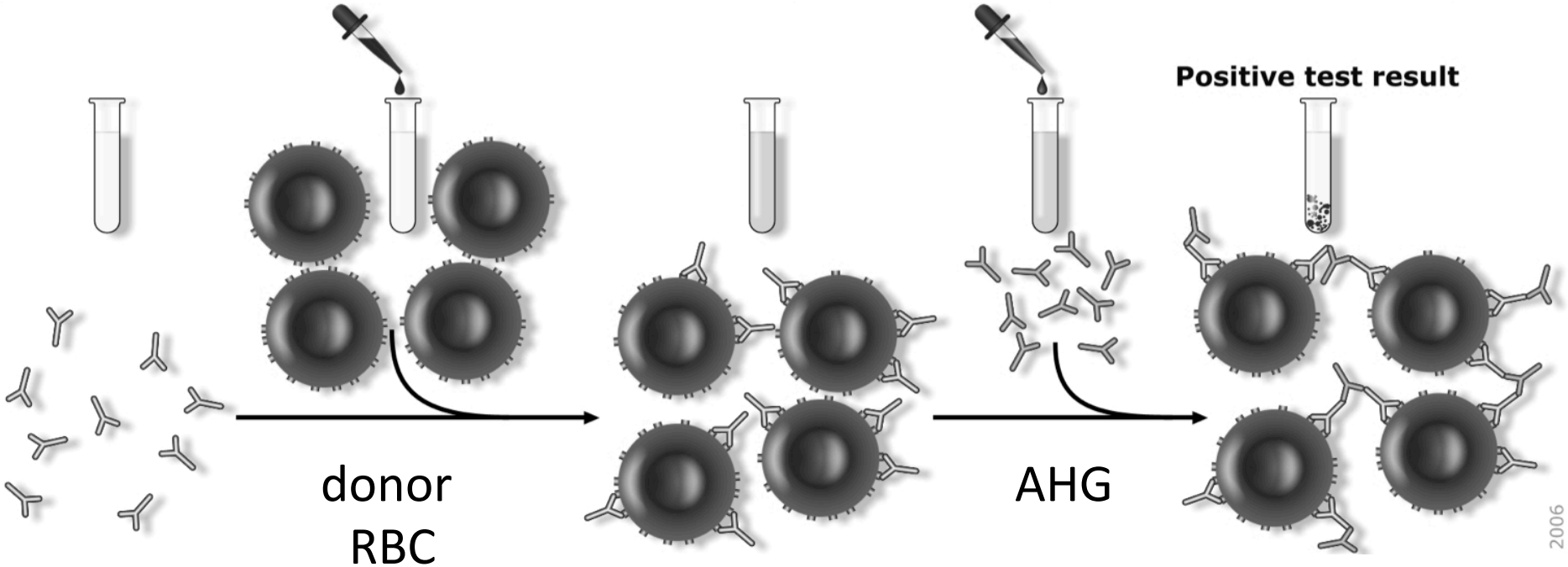
Forward typing is done using both anti-A and anti-B antibodies!

REVERSE TYPE



Reverse typing is done using both type A and type B reagent cells!

CROSSMATCH



patient
serum

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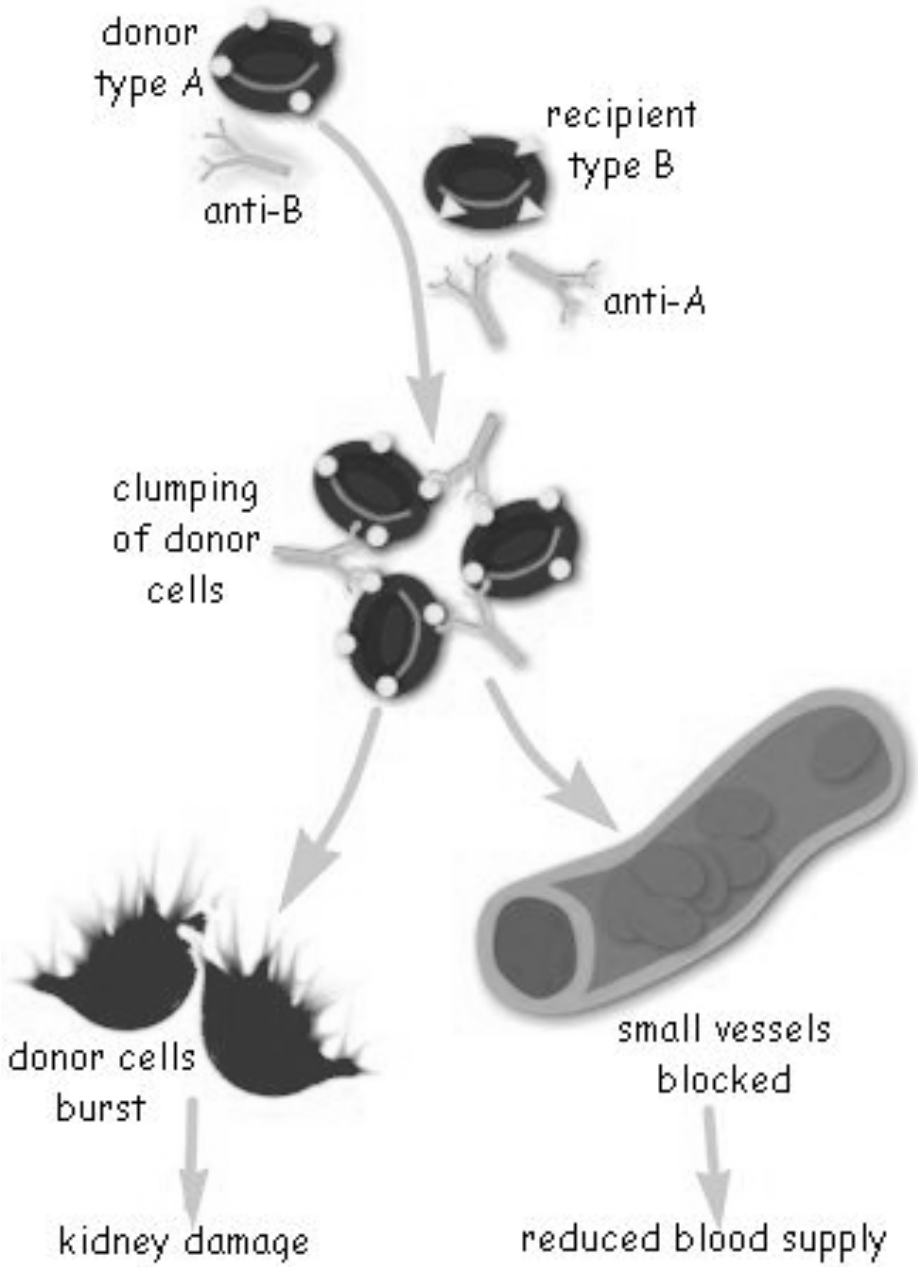
What can go wrong?

- Transfusion reactions
  - hemolytic
  - non-hemolytic
- Other complications
  - infections
  - circulatory overload
  - iron overload

Acute Hemolytic Transfusion Reactions

- Happen when patient has ABO antibodies against the donor red cells.
- Most common reason: clerical error!
- Symptoms: fever, chest pain, hypotension.
- Hemoglobin in serum, urine.
- Labs: ↓ haptoglobin, ↑ bilirubin, DAT positive.
- Type and cross-match shows ABO mismatch.


donor
type A
anti-B
recipient
type B
anti-A
clumping
of donor
cells
donor cells
burst
kidney damage
small vessels
blocked
reduced blood supply

Delayed Hemolytic Transfusion Reactions

- Hemolysis occurs days after transfusion.
- Caused by antibodies to non-ABO antigens.
- Hemolysis usually extravascular.
- Presentation: falling Hgb after transfusion.
- Usually not severe.
- DAT +. Antibody screen identifies the antibody.

Febrile Transfusion Reactions

- Caused by recipient antibodies against donor WBC.
- Cytokines → fever, headache, nausea, chest pain.
- Diagnosis: rule out everything else
- Treatment: Tylenol. Leukocyte-reduced components.

Allergic Transfusion Reactions

- Probably a host reaction to donor plasma proteins
- Symptom: hives
- Treatment: antihistamines
- Rarely, reaction is severe (anaphylaxis)

What do you do if you suspect a transfusion reaction?

- Stop the transfusion!
- Check if right blood went to right patient
- Monitor vitals
- Send blood, urine, and bag to blood bank

What does the lab do?

- Check paperwork
- Look for hemoglobinuria
- Do a DAT
- Repeat ABO, Rh testing

Infections

- Transfusion-related bacterial infection is an uncommon but serious risk.
- Patients suddenly develop fever and shock.
- Patient – and blood unit – must be tested.
- Treatment: aggressive resuscitation and antibiotic therapy.

Infections

- Donor tests: HIV, HTLV, Hepatitis B and C, syphilis.
- Despite testing, these diseases are still transmitted.
- Other transmissible infections:
  - viruses (EBV, CMV)
  - parasitic diseases (malaria, Lyme disease)

Circulatory Overload

- Happens when too much blood is given too quickly
- Symptoms: hypertension, congestive heart failure
- Stop transfusion, give diuretics

Iron Overload

- Too much iron can damage heart, liver
- Patients with chronic anemias are at biggest risk
- Give iron-chelating agents

What's the risk of getting an infection?

Bug	Risk
Bacterial infection	One in 50,000 - 500,000 *
Hepatitis B	One in 300,000
Hepatitis C	One in 2 million
HIV	One in 2 million

* 1 in 50,000 platelet transfusions; 1 in 500,000 RBC transfusions

What's the risk of other complications?

Complication	Risk
Allergic reaction	One in 100 (severe: one in 20,000)
Febrile reaction	One in 200
Circulatory overload	One in 3,000
Delayed hemolysis	One in 4,000 (fatal: one in 4 million)
Acute hemolysis	One in 20,000 (fatal: one in 600,000)