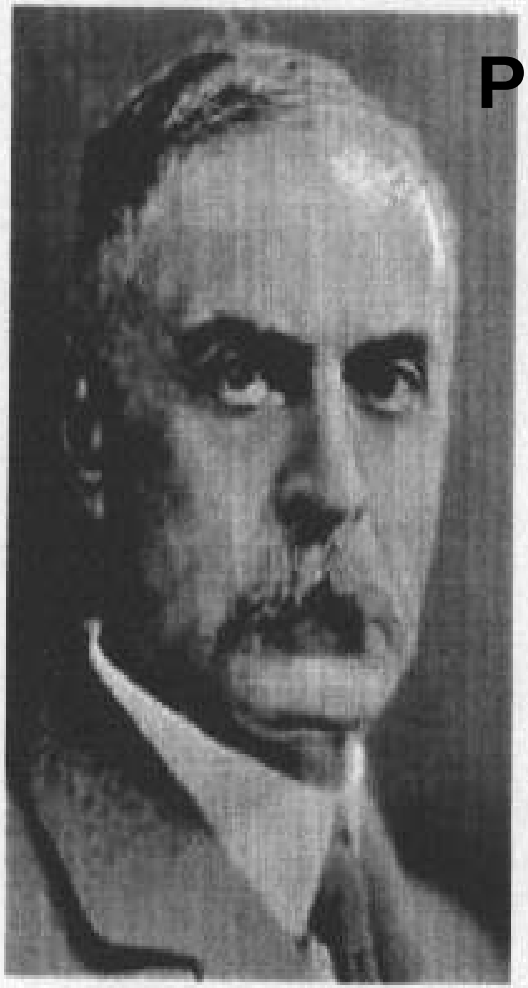
# Algorithm for the Resolution of Discrepancies of the ABO System

**Presented by Dra. Denise Harmening**
**Director of Instruction & Customer Learning**
**American Red Cross, Heritage Division**

**Professor, Department of Medical & Research Technology**
**University of Maryland School of Medicine**
**Baltimore, Maryland USA**

# Who am I?



## Historical Perspectives

- 1901-Karl Landsteiner drew blood from himself and five co-workers
- separated the cells and serum; mixed each cell sample with each serum
- first to perform forward and reverse grouping

# THE ABO SYSTEM: MOST IMPORTANT

## ABO GROUPING: RECIPROCAL RELATION

- **FORWARD GROUPING**
- **REVERSE GROUPING**
- **EXPECTED REACTIVITY: 3+ or 4+**

# ABO ANTIBODIES

- **NATURALLY OCCURING (expected)**
- **HIGH TITERED**
- **TYPICALLY IgM (small quantities of IgG may be present)**
  - **Exception: Group O which has a unique IgG Anti-A,B**
- **CANNOT CROSS PLACENTA (EXCEPT ANTI-A,B and IgG ANTI-A OR ANTI-B)**
- **BINDS & ACTIVATES COMPLEMENT**
- **CAPABLE OF CAUSING INTRAVASCULAR HEMOLYSIS**

# GROUP O INDIVIDUALS

- **Produce anti-A,B**
  - **Typically IgG**
  - **Separate entity**
  - **Importance**
    - **Intravascular and extravascular transfusion reaction-HTR**
    - **May cross placenta--ABO HDN**

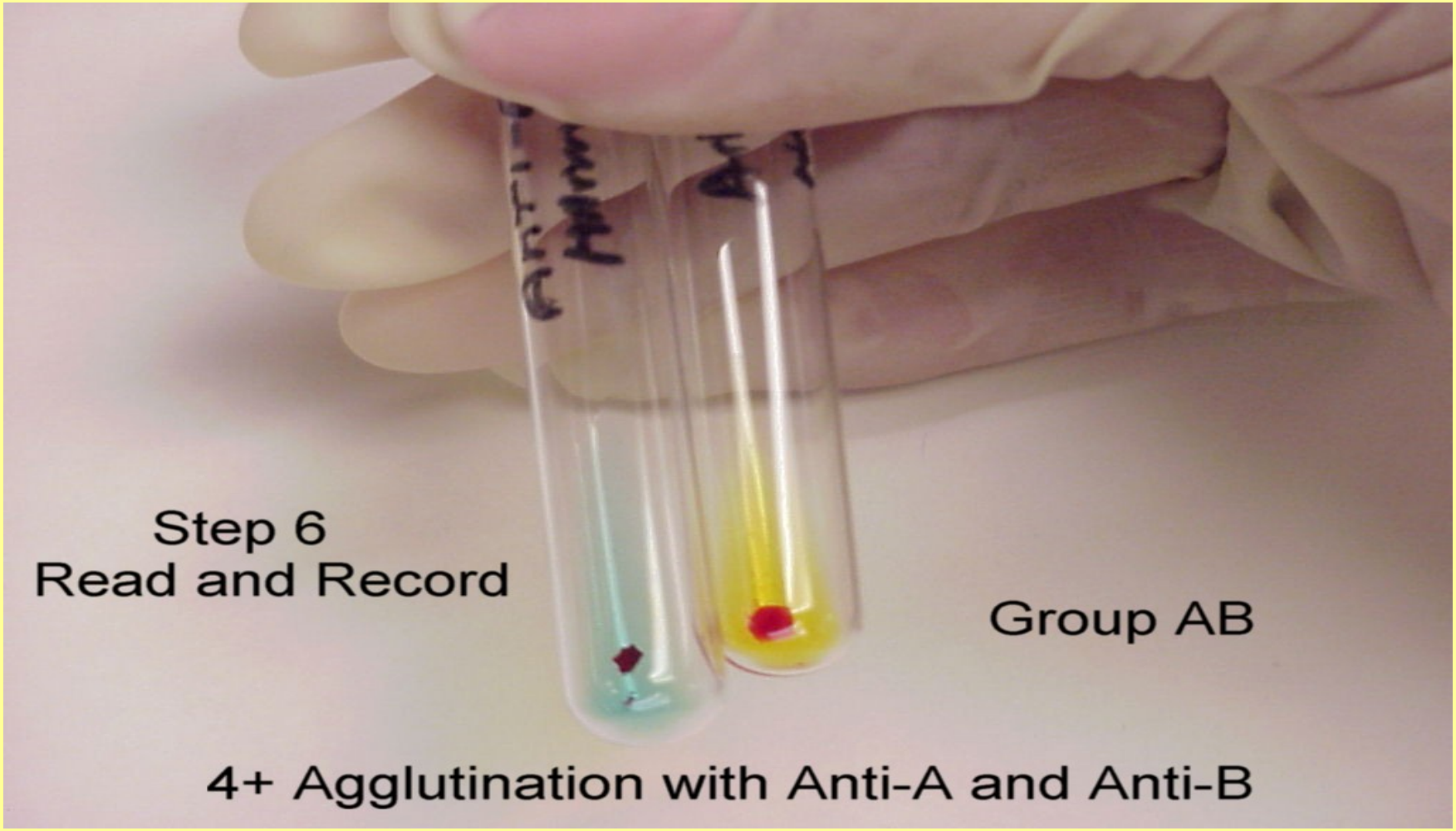
# ABO GROUPING

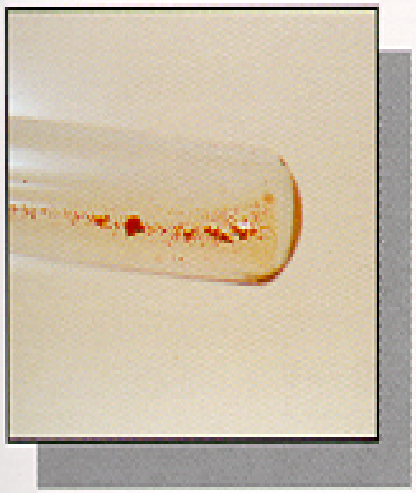
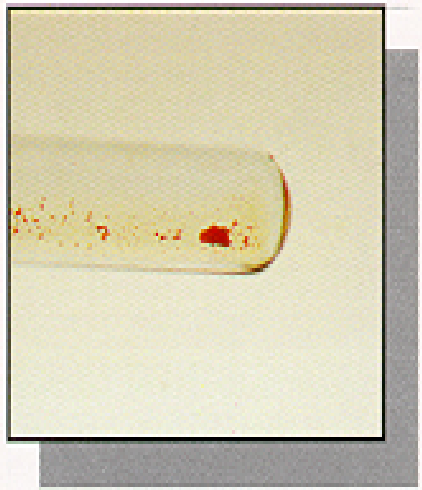
| FORWARD | | REVERSE | | |
|---|---|---|---|---|
| Anti-A Reagent | Anti-B Reagent | A1 cells Reagent | B cells Reagent | Interpret |
| 4+ | 0 | 0 | 4+ | A |
| 0 | 4+ | 4+ | 0 | B |
| 4+ | 4+ | 0 | 0 | AB |
| 0 | 0 | 4+ | 4+ | 0 |

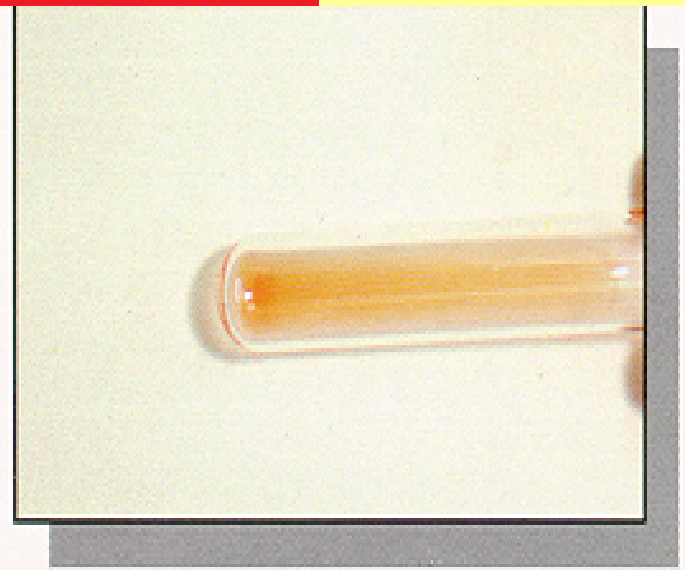
# Exception: Cord Blood / Neonates

- **Cord blood**
  - **Wash cells before testing**
  - **Serum testing not commonly performed**
- **Neonatal sample**
  - **Serum testing not commonly performed**

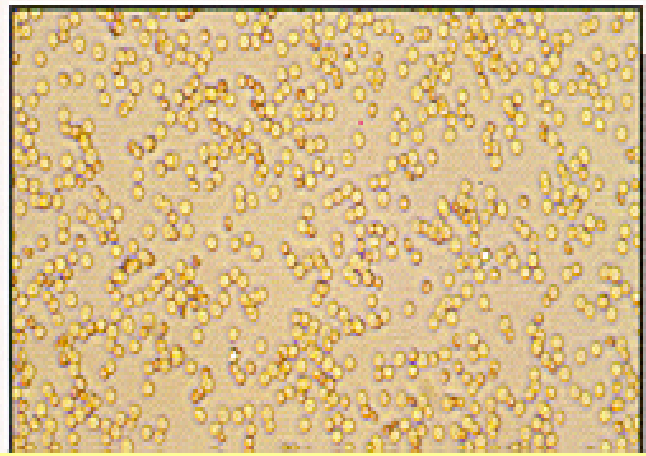
# Tube Testing: The Gold Standard



| 3+ | 4+ |
| --- | --- |
| SEVERAL LARGE AGGLUTINATES-CLEAR BACKGROUND | ONE SOLID AGGLUTINATE |
|  |  |
| SCORE: 9 | SCORE: 11 |



NEGATIVE: NO AGGREGATES



# Gel Technology

## How are reactions graded in blood banking?

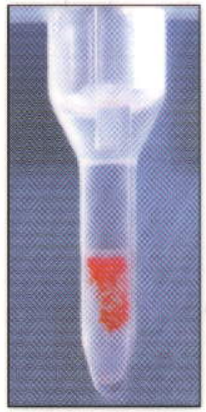
# GEL TECHNOLOGY

## ID-MTS Reaction Grading Chart

A **negative** reaction is characterized by unagglutinated red cells forming a well-delineated pellet at the bottom of the microtube.

A **1+** reaction is characterized by red cell agglutinates predominantly observed in the lower half of the gel column. Unagglutinated cells form a pellet in the bottom of the microtube.

A **2+** reaction is characterized by red cell agglutinates dispersed throughout the length of the gel column. Few agglutinates may be observed in the bottom of the microtube.



A **3+** reaction is characterized by the majority of red cell agglutinates trapped in the upper half of the gel column.

A **4+** reaction is characterized by a solid band of red cell agglutinates on top of the gel. A few agglutinates may filter into the gel but remain near the predominant band.

A **mixed cell** reaction is characterized by a band of red cell agglutinates on top of the gel, accompanied by a pellet of unagglutinated cells at the bottom of the microtube.

# ABO SYSTEM: A QUICK REVIEW

## INHERITANCE CODOMINANT

- FOLLOWS MENDEL'S LAW OF INHERITANCE
- INDIVIDUALS INHERIT ONE GENE FROM EACH PARENT
- TWO GENES DETERMINE TYPE
- *O* GENE IS AN AMORPH
- PHENOTYPE IS DESCRIBED AS A, B, AB, OR O BLOOD GROUPS

# AB x AB MATING

| GENES | *A* | *B* |
|---|---|---|
| *A* | *AA* | *AB* |
| *B* | *AB* | *BB* |

# EXCEPTION:RARE Cis-AB

- Inheritance of both *AB* genes from one parent carried on one chromosome and an *O* gene inherited from the other parent
- Offspring inherits three *ABO* genes
- B antigen reacts weaker with anti-B
- Serum contains anti-B which will react with normal B cells, not *cis-AB*

# ABH ANTIGENS

- Referred to as glycolipids on Rbc membrane
- Referred to as glycoproteins in secretions
- Inherited genes produce specific GLYCOLSYLTRANSFERASES that add sugars to basic precursor substances
- Develop as early as 37 days of gestation, but not fully developed at birth (Newborn antigens react weaker until fully developed at 6-18 months of age)
- Present on lymphocytes, platelets, kidney, epithelium tissue, etc.

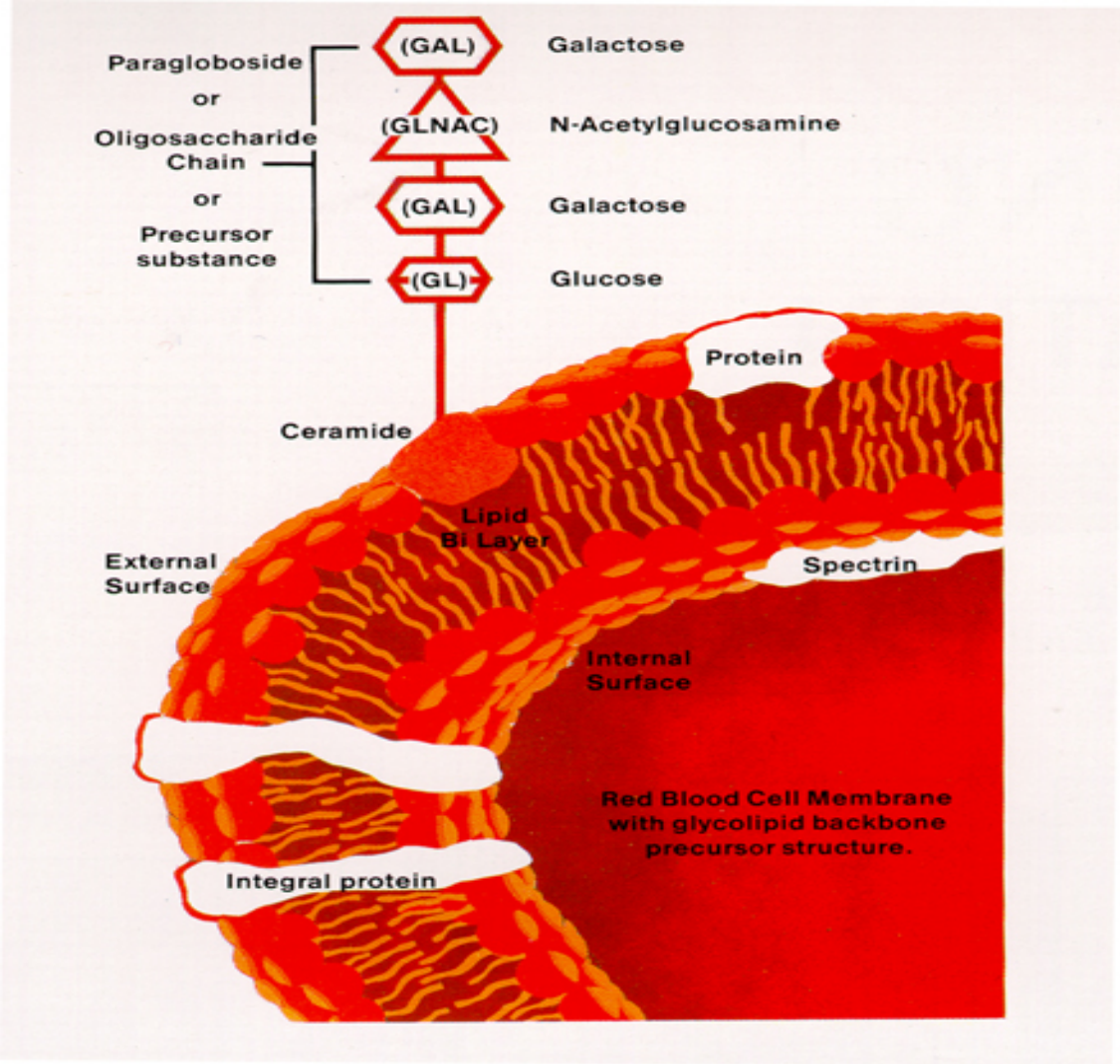
# RBC ANTIGEN EXPRESSION

- ABO Genes--chromosome 9
  - A and B encode, O is amorphic
- Hh Genes--chromosome 19
  - H encodes, h is amorphic

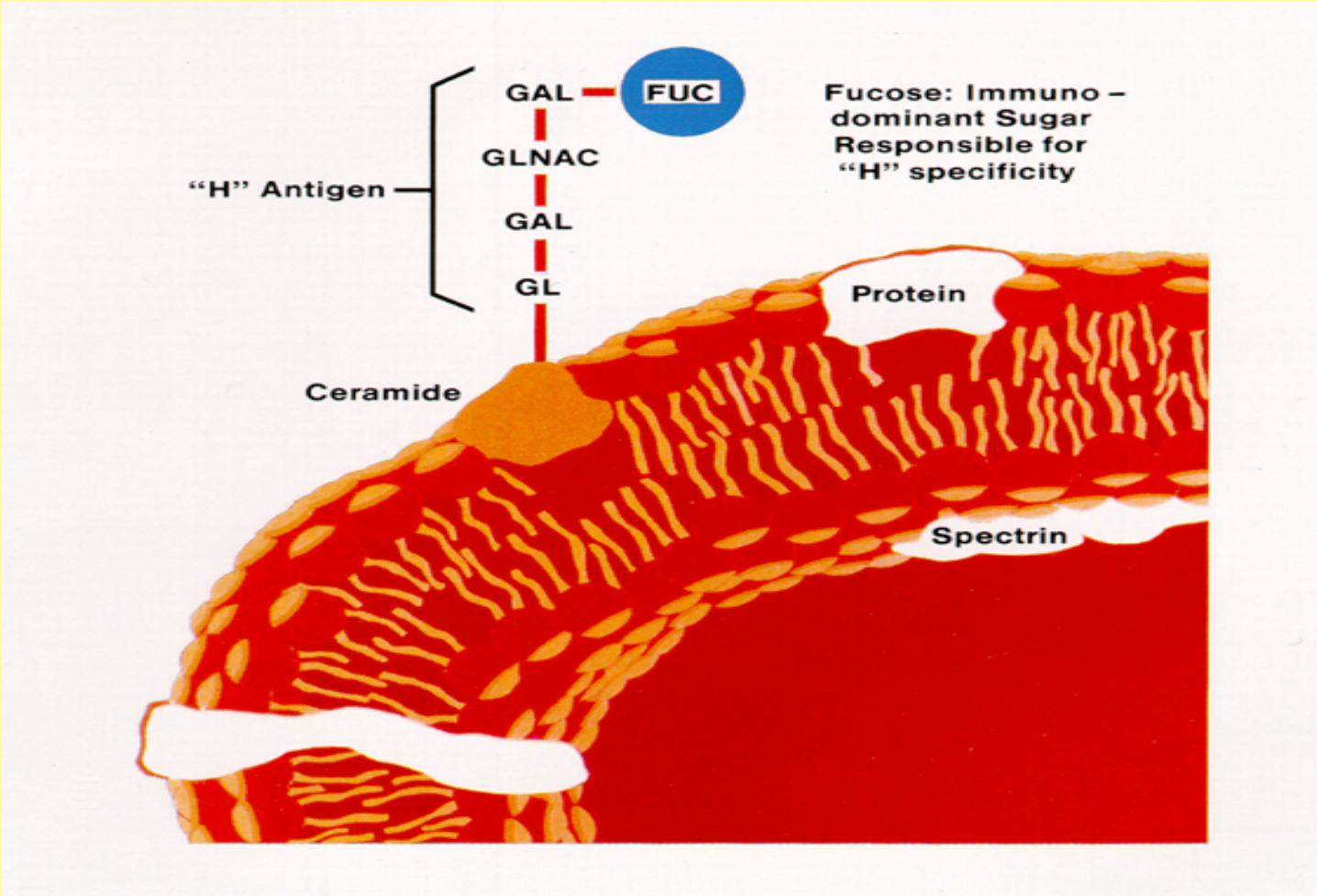
# GLYCOSYLTRANSFERASES AND IMMUNODOMINANT SUGARS RESPONSIBLE FOR H, A, AND B ANTIGEN SPECIFICITIES

| Gene | Glycosyltransferase | **Immunodominant Sugar** | **Antigen** |
|---|---|---|---|
| ***H*** | **α-2-L-fucosyltransferase** | **L-fucose** | **H** |
| ***A*** | **α-3-N-acetylgalactosaminyltransferase** | **N-acetyl-D-galactosamine** | **A** |
| ***B*** | **α-3-D-galactosyltransferase** | **D-galactose** | **B** |

# PARAGLOBOSIDE



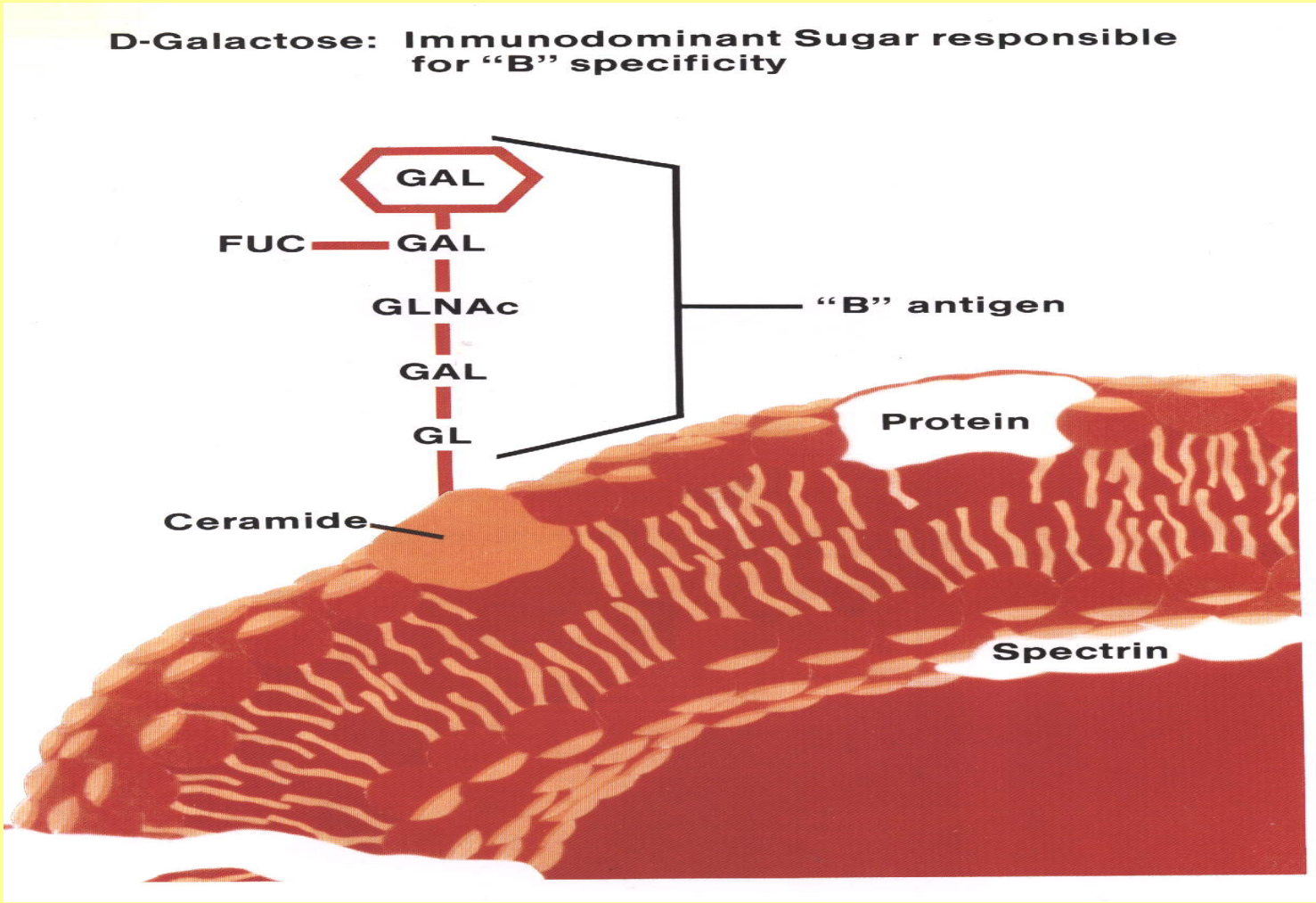
# H ANTIGEN



# H Antigen

- 99.99% frequency in population
- *hh* - Bombay phenotype
- ABO antigens cannot be expressed if the H gene was not inherited
- ABO expression is dependent upon H inheritance

# B ANTIGEN

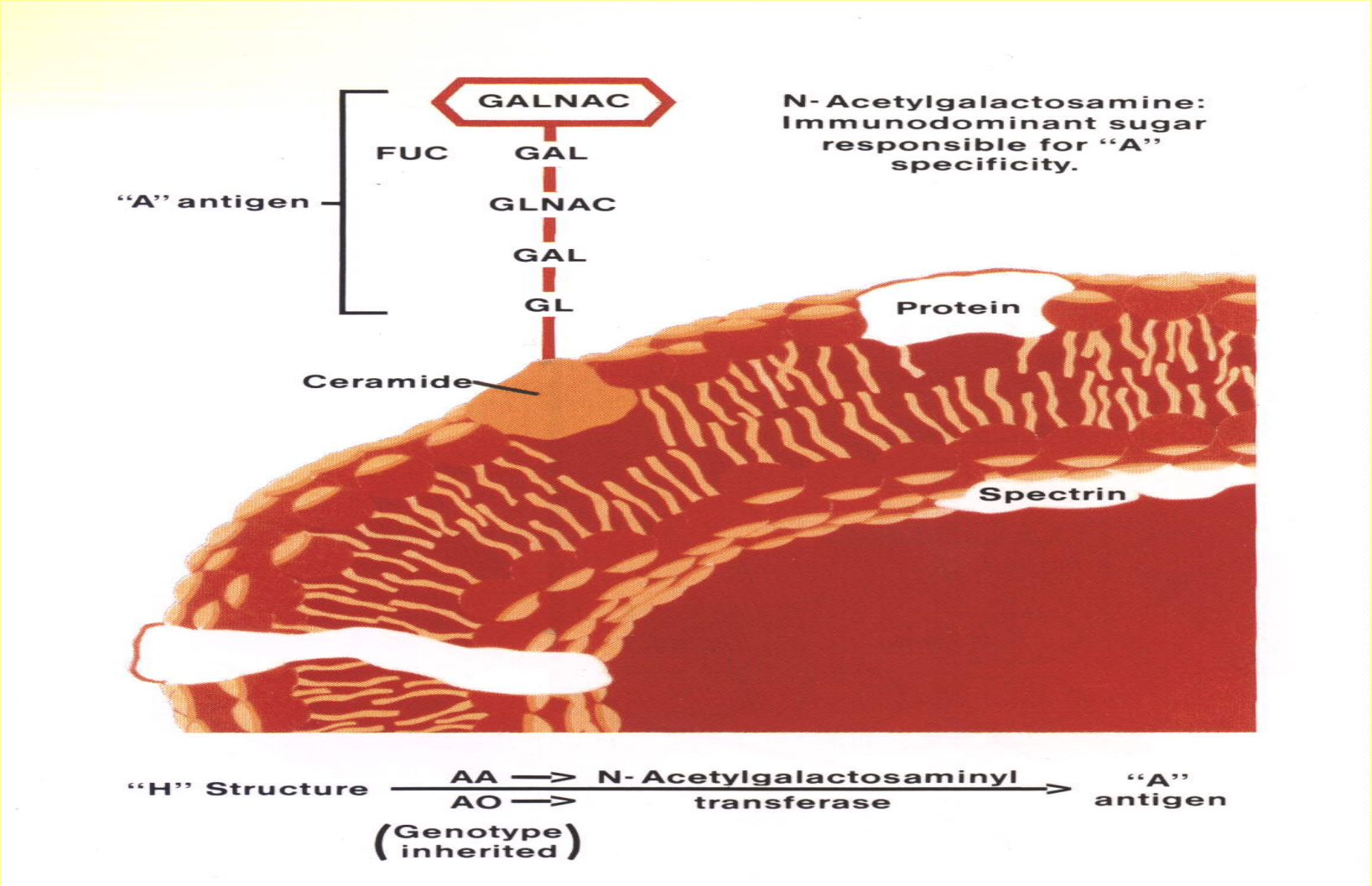



The need is constant.
The gratification is instant.
Give blood.™



American Red Cross

# A ANTIGEN




The need is constant.
The gratification is instant.
Give blood.™



American Red Cross

# RBC H ANTIGEN EXPRESSION

**$O > A_2 > B > A_2B > A_1 > A_1B$**

**most H ----------> least H**

# What are the frequencies of ABO in the US Population?

**Table 5–3.** ABO Phenotype Frequencies in U.S. Populations

| Phenotype | White (%) | Black (%) | Mexican (%) | Asian (%) |
|---|---|---|---|---|
| O | 45 | 49 | 56 | 43 |
| $A_1$ | 33 | 19 | 22 | 27 |
| $A_2$ | 8 | 8 | 6 | Rare |
| B | 10 | 19 | 13 | 25 |
| $A_1B$ | 3 | 3 | 4 | 5 |
| $A_2B$ | 1 | 1 | Rare | Rare |

• Garratty G, Glynn SA, McEntire R : ABO and Rh (D) phenotype frequencies of different racial/ethnic groups in the United States. Transfusion 44:703-706, 2004.

# ABO DISCREPANCIES

- **No reciprocal relationship between the forward and reverse grouping**
- **You may have missing, extra, or weak Rx due to:**
  - **Technical errors**
  - **Unexpected reactions (reverse group- problems with serum)**
  - **Unexpected reactions (forward group- problems with red cells)**
  - **Unexpected reactions (both forward and reverse)**

# Common Sources of Technical Errors Resulting in ABO Discrepancies

- **Inadequate identification of blood specimens, test tubes, or slides**
- **Cells suspension either too heavy or too light**
- **Clerical errors**
- **A mix-up in samples**
- **Missed observation of hemolysis**

# Common Sources of Technical Errors Resulting in ABO Discrepancies

- Failure to add reagents
- Failure to follow manufacturer's instructions
- Uncalibrated centrifuge
- Under centrifugation
- Over centrifugation
- Contaminated reagents
- Warming during centrifugation

# ALGORITHM/ GENERAL GUIDELINES FOR RESOLUTION OF ABO DISCREPANCIES

- **ALWAYS WASH PATIENT RBC SUSPENSION WITH NORMAL SALINE AND**
- **ALWAYS REPEAT THE TEST**
- **ALWAYS OBTAIN THE PATIENT'S HISTORY, AGE, DIAGNOSIS, TRANSFUSION HISTORY AND MEDICATIONS, IF POSSIBLE**

**IF PROBLEM PERSISTS:**

- **TEST PATIENT'S CELLS WITH AVAILABLE LECTINS AND ANTI-A,B REAGENT**
- **TEST PATIENT'S SERUM WITH O, A1, A2, & B CELLS**
- **RUN AUTO CONTROL AND DAT**

# ALGORITHM/ GENERAL GUIDELINES FOR RESOLUTION OF ABO DISCREPANCIES

## IF PROBLEM PERSISTS:

- INCREASE INCUBATION TIME
- DECREASE TEMPERATURE OF TESTING
- RUN ANTIBODY SCREEN & PANEL, IF NECESSARY
- ENZYME TREAT CELLS, IF NEEDED
- USE OF ADSORPTION/ELUTION TECHNIQUES
- SALIVA STUDIES

# Where is the Discrepancy?

| Anti-A Reagent | Anti-B Reagent | A1 cells Reagent | B cells Reagent | Interpret |
|---|---|---|---|---|
| 4+ | 0 | 1+ | 4+ | |
| | | | | |

# ALGORITHM FOR RESOLUTION

- **ALWAYS REPEAT THE TEST**
- **OBTAIN PATIENT HISTORY, AGE, DIAGNOSIS, TRANSFUSION HISTORY AND MEDICATIONS**
- **TEST PATIENT'S CELLS WITH ANTI-A,B & ANTI-$A_1$ LECTIN**
- **TEST PATIENT'S SERUM FOR ANTI-$A_1$**
  - **Test patient serum against A1, A2, B & O cells**
  - **Run Auto Control**

# PATIENT RESULTS FROM ADDITIONAL TESTING

**Patient is a 22 year-old man with no history of a transfusion.**

| Reagent Anti-sera | | | | Reagent red cells | | | | |
|---|---|---|---|---|---|---|---|---|
| A | B | A,B | A1 LECTIN | A1 | A2 | B | 0 | AUTO CONT |
| 4+ | 0 | 4+ | 0 | 1+ | 0 | 4+ | 0 | 0 |
| | | | | | | | | |

# INTERPRETATION

- **Patient $A_2$ with Anti-$A_1$**
- **Transfuse Group O packed Rbc's**

**Note: Anti-$A_1$ is found in 1-8% of $A_2$ serum and in 22-35% of $A_2B$ serum. It is a cold reacting antibody and is usually clinically insignificant.**

# Main Subgroups of A: Quick Review

- **Comprises 80% of Group A Persons**
- **$A_1$-group A cells react with both Anti-A and Anti-$A_1$**
- **> 2 million antigenic sites per red cell**
- **Agglutinated by anti-$A_1$ Lectin**

# Main Subgroups of A

- $A_2$ group A red cells only react with Anti-A
- Approx. 19 to 20% of Group A persons belong to $A_2$
- Approx. 500,000 antigen sites
- < 1% of Group A : other weaker subgroup
- Red cells contain fewer antigen sites
- $A_2$ individuals have less transferase enzyme
- 1 to 8% produce anti-$A_1$
- 22-35% produce anti-$A_1$ in $A_2B$ persons

# MAIN SUBGROUPS OF A

| Phen | Reaction of cells with reagent antiserum | | | | | | Reaction of serum with reagent cells | | | | Saliva |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | A,B | H | $A_1$ | | $A_1$ | $A_2$ | B | O | |
| $A_1$ | 4+ | 0 | 4+ | 0 | 4+ | | 0 | 0 | 4+ | 0 | A, H* |
| | | | | | | | | | | | |
| $A_2$ | 4+ | 0 | 4+ | 2+ | 0 | | 1+/0 | 0 | 4+ | 0 | A, H* |
| | | | | | | | | | | | |

* IF SE GENE IS INHERITED

# Lectins

- Proteins present in plants which bind specifically to CHO determinants and agglutinate erythrocytes by their cell surface oligosaccharide determinants
- ***Dolichos biflorus***-Agglutinates $A_1$ or $A_1B$
- ***Bandeiraea simplicifolia-*** B cells
- ***Ulex europaeus-*** H specificity

# In what order of decreasing strength would *Ulex europeaus* *( Anti-H ) react?*

$O > A_2 > B > A_2B > A_1 > A_1B$

# OTHER SUBGROUPS OF A

- **$A_3$ subgroup**
  - **typically demonstrates 2+mf with Anti A and Anti A,B**
  - **sometimes produces Anti-$A_1$**
- **$A_x$ demonstrates weak to negative reactions with Anti-A and usually 2+ reactions with Anti-A,B; usually makes Anti-$A_1$**
- **All other weaker subgroup, A specificity can only be demonstrated by absorption/elution procedures**

# OTHER SUBGROUPS OF A

| Phen | Reaction of cells with reagent antiserum | | | | | Reaction of serum with reagent cells | | | | Saliva |
|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | A,B | H | $A_1$ | $A_1$ | $A_2$ | B | O | |
| $A_3$ | 2+ mf | 0 | 2+ mf | 3+ | 0 | 1+/0 | 0 | 4+ | 0 | A,H* |
| $A_m$ | 0/ +/- | 0 | 0/ +/- | 4+ | 0 | 0 | 0 | 4+ | 0 | A,H* |
| $A_x$ | 0/ +/- | 0 | 1+/ 2+ | 4+ | 0 | 2+/ 0 | 0 | 4+ | 0 | H |
| $A_{el}$ | 0 | 0 | 0 | 4+ | 0 | 2+/ 0 | 0 | 4+ | 0 | H |

**IF SE GENE IS INHERITED**

# Subgroups of B: A Quick Review

| Phen | Reaction of cells with reagent antiserum | | | | Reaction of serum with reagent cells | | | | Saliva |
|---|---|---|---|---|---|---|---|---|---|
| | A | B | A,B | H | $A_1$ | $A_2$ | B | O | |
| B | 0 | 4+ | 4+ | 2+ | 4+ | 4+ | 0 | 0 | B,H* |
| $B_3$ | 0 | 1+ mf | 2+ mf | 3-4+ | 4+ | 4+ | 0 | 0 | B,H* |
| $B_m$ | 0 | 0 | 0/ +/- | 3-4+ | 4+ | 4+ | 0 | 0 | B,H* |
| $B_x$ | 0 | 0/ +/- | 0/ 1+ | 3-4+ | 4+ | 4+ | 0 | 0 | H |

**IF SE GENE IS INHERITED**

# Where is the Discrepancy?

| Anti-A Reagent | Anti-B Reagent | A1 cells Reagent | B cells Reagent | Interpret |
|---|---|---|---|---|
| 0 | 4+ | W+ | 0 | |
| | | | | |

# RESOLUTION

- **ALWAYS REPEAT THE TEST**
- **OBTAIN PATIENT HISTORY, AGE, DIAGNOSIS, TRANSFUSION HX & MEDICATIONS**
- **INCUBATE PATIENT'S PLASMA AND REAGENT CELLS FOR 15-30 MINUTES AT ROOM TEMPERATURE 0R 15 MIN. AT $4^0$ C**
- **ALWAYS RUN O CELLS AND AUTO CONTROL**

# PATIENT RESULTS FROM ADDITIONAL TESTING

**Eighty-six year old patient with a bleeding ulcer and no history of transfusion**

**RESULTS OF RT INCUBATION**

| FORWARD | | REVERSE | | | |
|---|---|---|---|---|---|
| Anti-A | Anti-B | $A_1$ cells | B cells | O cells | Auto control |
| 0 | 4+ | 3+ | 0 | 0 | 0 |

# INTERPRETATION

- Group B
- Elderly patient > 80 years old
- Transfuse Group B Rbc's, if Antibody screen is negative

# Where is the Discrepancy?

| Anti-A Reagent | Anti-B Reagent | A1 cell Reagent | B cell Reagent | Interpret |
|---|---|---|---|---|
| 0 | 4+ | 4+ | 2+ | |
| | | | | |

# Unexpected Rxns (Reverse)

- Cold Reacting Alloantibody
  (i.e. Anti-M, Anti-$P_1$ most common)

- Cold Reacting Autoantibody
  (i.e. Anti-I, Anti-H, Anti-IH)

- Passively Acquired Antibody
  (i.e. plasma exchange, mismatched Platelets)

# ADDITIONAL TESTING AND INVESTIGATION

- **ALWAYS REPEAT THE TEST**
- **OBTAIN PATIENT HISTORY, AGE, DIAGNOSIS, TRANSFUSION HX & MEDICATIONS**
- **RUN O CELLS, AUTO CONTROL, AB SCREEN**

| FORWARD | | | REVERSE | | | |
|---|---|---|---|---|---|---|
| A | B | A,B | A1 | B | O | AUTO CONT |
| 0 | 4+ | 4+ | 4+ | 2+ | 2+ | 0 |
| | | | | | | |

# ANTIBODY SCREENING RESULTS

- **POSITIVE ANTIBODY SCREEN**
- **NEGATIVE AUTO CONTROL**

**THINK: ALLOANTIBODY**

- **Perform antibody ID**
- **Type reagent B cells for the specific antigen of the identified antibody to explain the reagent B cell reaction in the reverse grouping**

---

**IF AUTO CONTROL IS POSITIVE**

**THINK: AUTOANTIBODY**

- **• Perform cold panel, autoabsorption if patient has not been transfused within the last 3 months, or alloadsorption using REST**
- **• Repeat Reverse grouping using the absorbed serum or repeat reverse testing at $37^0$**
- **• Run panel on absorbed serum to detect any underlying cold or RT reacting alloantibodies**

# Where is the Discrepancy?

| Anti-A Reagent | Anti-B Reagent | A1 cell Reagent | B cell Reagent | Interpret |
|---|---|---|---|---|
| 4+ | 4+ | 2+ | 2+ | |
| | | | | |

**If the patient is AB Rh pos, you would need to run a saline control.**

# ADDITIONAL TESTING AND INVESTIGATION

- **ALWAYS REPEAT THE TEST**
- **OBTAIN PATIENT HISTORY, AGE, DIAGNOSIS, TRANSFUSION HX & MEDICATIONS**
- **RUN ANTIBODY SCREEN & PANEL IF NECESSARY**

# REPEAT TESTING

| Reaction of red cells with reagent antiserum | | | | Reaction of serum with reagent cells | | | |
|---|---|---|---|---|---|---|---|
| A | B | A,B | | $A_1$ | B | O | Auto ct |
| 4+ | 4+ | 4+ | | 2+ | 2+ | 2+ | 2+ |

**IS THIS:**

**Group AB--Cold autoantibody (anti-I)?**

**Group AB--Cold autoantibody (anti-I) and cold alloantibody (anti-M, $P_1$, $Le^a$, $Le^b$) ?**

**Group AB—Rouleaux?**

# PATIENT HISTORY

**PATIENT IS AN 82 YEAR OLD BLACK MAN WITH A DIAGNOSIS OF MULTIPLE MYELOMA WITH NO HISTORY OF A TRANSFUSION**

**CONSIDER:**

ROULEAUX FORMATION: "**stack of coins**" appearance of agglutination under the microscope

- High protein concentration in patient serum alters net negative charge on RBC yielding pseudoagglutination

# ADDITIONAL TESTING AND INVESTIGATION

- Perform Saline Replacement (assuming cell suspensions are not routinely washed ).
  - Remove serum from test tube & replace with equal number of drops of saline.

Results of saline replacement

| ANTI-A | ANTI-B | A1 CELLS | B CELLS | AUTO |
|---|---|---|---|---|
| 4+ | 4+ | 0 | 0 | 0 |

# INTERPRETATION

- GROUP AB
- TRANSFUSE GROUP AB

# 0THER CAUSES OF ROULEAUX

- Other Plasma Cell Dyscrasias
- Wharton's jelly ( newborn Cord samples)
- Dextran or hydroxy ethyl starch IV infusion (Crosslinks RBCs yielding pseudoagglutination)

# Where is the Discrepancy?

| Anti-A Reagent | Anti-B Reagent | A1 cell Reagent | B cell Reagent | Interpret |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | |
| | | | | |

- **PATIENT HISTORY IS IMPORTANT**

# RESOLUTION

## PATIENT HISTORY

- NEWBORN REQUIRING SURGERY FOR A HEART DEFECT
- GROUP O

**NOTE: Neonatal samples**

- **Serum testing not commonly performed**

# Unexpected Rxns (Reverse)

- **Elderly**
- **Newborns**
- **Hypogammaglobulinemia (e.g. CLL, malignant lymphoma,**
- **Immunodeficiency diseases**
- **Transplant Patients**
- **ABO Subgroups**
- **Patients who received plasma transfusions or exchanges**

# Where is the Discrepancy?

| Anti-A Reagent | Anti-B Reagent | A1 cells Reagent | B cells Reagent | Interpret |
|---|---|---|---|---|
| 2+mf | 0 | 0 | 4+ | |
| | | | | |

# ABO DISCREPANCY: RED CELL PROBLEM

## CAUSE OF DISCREPANCY?

- Group A recently transfused with Group O red cells
- Group A recently transplanted with Group O BM or PBSC
- Group $A_3$ subgroup that exhibits characteristic mixed-field agglutination

| Anti-A Reagent | Anti-B Reagent | A1 cells Reagent | B cells Reagent | Interpret |
|---|---|---|---|---|
| 2+mf | 0 | 0 | 4+ | |
| | | | | |

# RESOLUTION

- **ALWAYS WASH PT CELLS, REPEAT THE TEST**
- **OBTAIN PATIENT HISTORY, AGE, DIAGNOSIS, TRANSFUSION HX & MEDICATIONS**
- **TEST PATIENT'S CELLS WITH LECTINS IF AVAILABLE**
- **RUN DAT AND AUTO**

# PATIENT RESULTS FROM ADDITIONAL TESTING

**The patient is a 16 year-old boy with no history of a transfusion.**

| Reagent Anti-sera | | | | Reagent red cells | | | | |
|---|---|---|---|---|---|---|---|---|
| A | B | A,B | H LECTIN | A1 | B | 0 | DAT | AUTO CONT |
| 2+mf | 0 | 2+mf | 3+ | 0 | 4+ | 0 | 0 | 0 |
| | | | | | | | | |

# INTERPRETATION

- $A_3$ Subgroup
- Transfuse Group O packed Rbc's

**This case shows the importance of transfusion history.**

# Where is the Discrepancy?

| Anti-A Reagent | Anti-B Reagent | A1 cell Reagent | B cell Reagent | Interpret |
|---|---|---|---|---|
| 4+ | 1+ | 0 | 4+ | |
| | | | | |

# RESOLUTION

- **ALWAYS WASH PT CELLS, REPEAT THE TEST**
- **OBTAIN PATIENT HISTORY, AGE, DIAGNOSIS, TRANSFUSION HX & MEDICATIONS**
- **RUN AUTOCONTROL**
- **TEST CELLS WITH HUMAN DERIVED ANTI-B REAGENT THAT HAS BEEN ACIDIFIED TO PH OF 6.0**

  **(ACIDIFIED ANTI-B REACTS ONLY WITH TRUE "B" ANTIGEN)**

  **OR**
- **TEST PT CELLS WITH *BANDEIRA SIMPLICIFOLIA* (BS-1) IF AVAILABLE**

  **(LECTIN ONLY REACTS WITH TRUE "B" ANTIGEN)**

# PATIENT RESULTS FROM ADDITIONAL TESTING

## PATIENT HISTORY: PATIENT HAS INTESTINAL BLOCKAGE AND REQUIRES SURGERY

| ANTI-A | ANTI-B | A1 CELLS | B CELLS | AUTO CONT | BS-1 lectin |
|---|---|---|---|---|---|
| 4+ | 0 | 0 | 4+ | 0 | 0 |

- NOTE: Patient's anti-B will NOT react with: acquired "B" and BS-1 – lectin reacts with true "B" antigen

# INTERPRETATION

- **GROUP A with Acquired B Phenomenon**
  - **Intestinal blockage→ back-up of E. coli**
  - **E. coli enzyme modifies "A" antigen into "B" like specificity**
  - **Seen in Group A individuals**

- **Acriflavin dye**
  - **A few patients, on rare occasions, have antibodies against acriflavin, a yellow dye used in some commercial anti-B reagent. The acriflavin-antiacroflavin complex attaches to the patient's RBCs causing agglutination in the forward testing.**

# Unexpected Rxns (Forward)

- **Out of Group Transfusion (i.e. Group O transfused to an A or B patient)**
- **Out of Group Transfusion Bone Marrow Transplantation**
- **Leukemia/Lymphoma**
- **Subgroups**
- **Hodgkins Disease**
- **Acquired B Phenomena**
- **Warm autoantibodies**

# Where is the Discrepancy?

| Anti-A Reagent | Anti-B Reagent | A1 cell Reagent | B cell Reagent | Interpret |
|---|---|---|---|---|
| 0 | 0 | 4+ | 0 | |
| | | | | |

# RESOLUTION

- **ALWAYS WASH PT CELLS**
- **REPEAT THE TEST**
- **OBTAIN PATIENT HISTORY, AGE, DIAGNOSIS, TRANSFUSION HX & MEDICATIONS**

# PATIENT RESULTS FROM ADDITIONAL TESTING

PATIENT IS A 26 YEAR OLD MALE WITH ADENOCARCINOMA IN THE LIVER, STOMACH, AND INTESTINES.

**WASHED PT RBCS**

| ANTI-A | ANTI-B | A1 CELLS | B CELLS | INT | |
|---|---|---|---|---|---|
| 0 | 3+ | 4+ | 0 | | |

# INTERPRETATION

- **Group B, transfuse Group B blood**
- **Certain tumors release increased amounts of soluble substance with A &/or B substance**

  **(Adenocarcinomas of pancreas, stomach, ovary & biliary system)**
- **Soluble A or B substances neutralizes anti-A or Anti-B reagent in Forward Grouping**

# Where is the Discrepancy?

| Anti-A Reagent | Anti-B Reagent | A1 cell Reagent | B cell Reagent | Interpret |
|---|---|---|---|---|
| 0 | 4+mf | 3+ | 0 | |
| | | | | |

**POSSIBILTIES?**

- **GROUP B PREVIOUSLY TRANSFUSED WITH GROUP O**
- **GROUP B WITH O BMT**
- **GROUP B EXCHANGE TRANSFUSION WITH GROUP O**
- **$B_3$ SUBGROUP**

# RESOLUTION

- **ALWAYS WASH PT CELLS**
- **REPEAT THE TEST**
- **OBTAIN PATIENT HISTORY, AGE, DIAGNOSIS, TRANSFUSION HX & MEDICATIONS**
- **RUN AUTO CONTROL, O CELLS, DAT**

# RESOLUTION

- **PATIENT HISTORY:**
  - **PATIENT IS A 45 YEAR OLD FEMALE ADMITTED TO SHOCK TRAUMA WITH MASSIVE INTERNAL INJURIES FROM A CAR ACCIDENT**
  - **SIX UNITS OF O NEG BLOOD AND 2 UNITS OF FFP FROM B+ DONOR WAS GIVEN TO THE PATIENT**

| FORWARD | | | | REVERSE | | | | |
|---|---|---|---|---|---|---|---|---|
| A | B | A,B | H LECTIN | A1 | B | 0 | DAT | AUTO CONT |
| 0 | 4+mf | 4+mf | 3+ | 4+ | 0 | 0 | 0 | 0 |
| | | | | | | | | |

# INTERPRETATION

- **TRANSFUSION OF GROUP O RBCs TO B PATIENT**

- **THE MOST COMMON CAUSE OF MIXED FIELD AGGLUTINATION IS TRANSFUSION OF O CELLS TO AN A OR B PATIENT**

# OTHER CAUSES OF MIXED FIELD AGGLUTINATION

- **OUT OF GROUP BONE MARROW TRANSPLANTATION**
- **FETAL-MATERNAL BLEED**

# UNEXPECTED RESULTS IN THE FORWARD AND REVERSE GROUPING

- **CHIMERISM**

# Twins

| | Anti-A Reagent | Anti-B Reagent | Anti-A,B | A1 cell | B cell |
|---|---|---|---|---|---|
| Twin1 | 0 | 2+mf | 2+mf | 4+ | 0 |
| Twin 2 | 0 | +wk | +wk | 4+ | 0 |

- Twin 1 70% B 30% O
- Twin 2 30% B 70% O

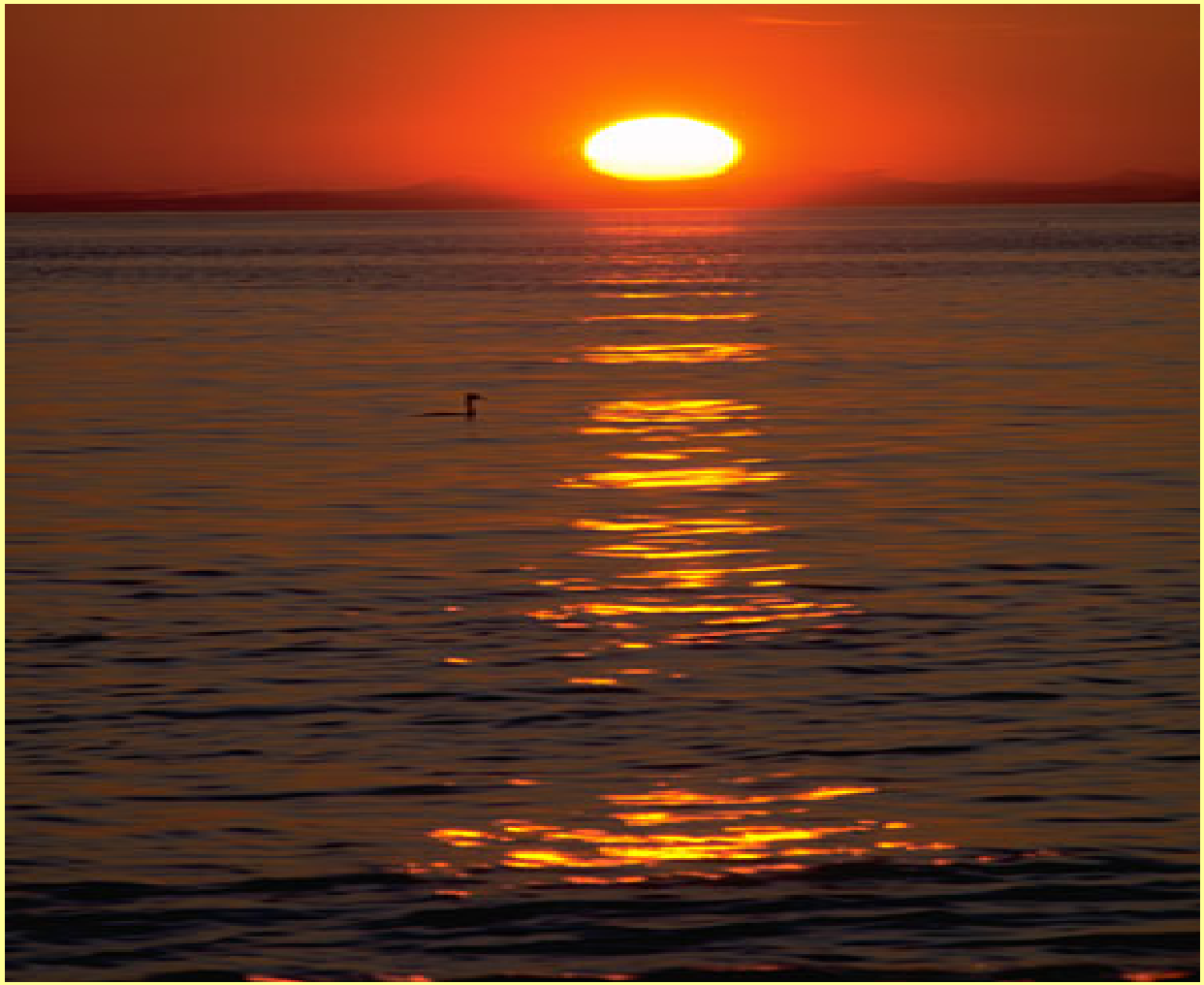
# NETWORKING AND COOPERATION GIVES SOLUTIONS TO PROBLEMS


The need is constant.
The gratification is instant.
Give blood.™



American Red Cross

# THE END



The need is constant.
The gratification is instant.
Give blood.™



American Red Cross

# INHERITANCE OF Cis-AB

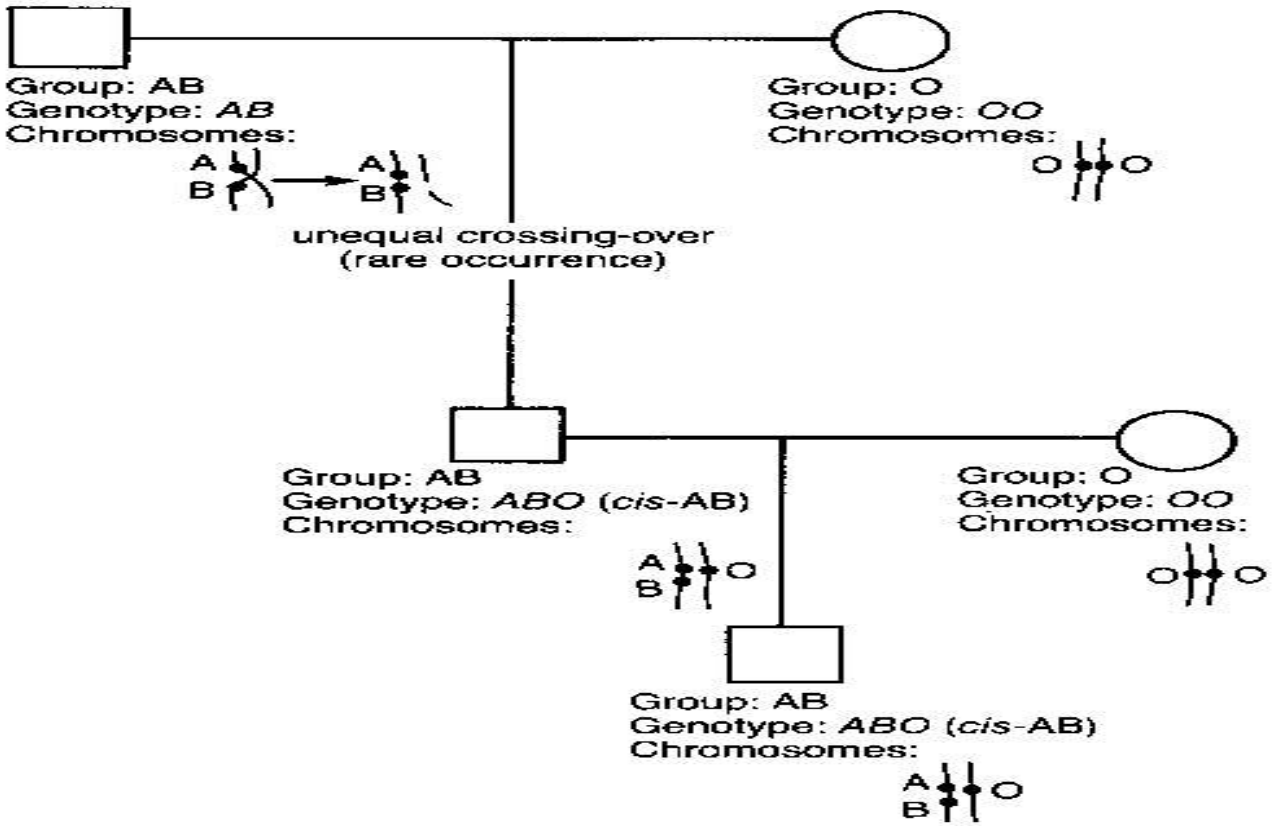



**Figure 5–19.** Example of cis-AB inheritance to unequal crossing-over. □ = male; ○ = female. (From Harmening-Pittiglio,[33] p 7 with permission.)