Algorithm for the Resolution of Discrepancies of the ABO System

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University of Maryland School of Medicine
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The need is constant.
The gratification is instant.
Give blood.
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

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THE ABO SYSTEM: MOST IMPORTANT

ABO GROUPING: RECIPROCAL RELATION

• FORWARD GROUPING
• REVERSE GROUPING
• EXPECTED REACTIVITY: 3+ or 4+

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ABO ANTIBODIES

- NATURALLY OCCURRING (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
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<table>
<thead>
<tr>
<th>ABO GROUPING</th>
<th>FORWARD</th>
<th>REVERSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anti-A Reagent</td>
<td>Anti-B Reagent</td>
</tr>
<tr>
<td></td>
<td>4+</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>4+</td>
</tr>
<tr>
<td></td>
<td>4+</td>
<td>4+</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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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

Step 6
Read and Record

Group AB

4+ Agglutination with Anti-A and Anti-B

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Gel Technology

How are reactions graded in blood banking?
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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
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<table>
<thead>
<tr>
<th>GENES</th>
<th>(A)</th>
<th>(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>(AA)</td>
<td>(AB)</td>
</tr>
<tr>
<td>(B)</td>
<td>(AB)</td>
<td>(BB)</td>
</tr>
</tbody>
</table>
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.
• ABO Genes--chromosome 9
  – A and B encode, O is amorphic
• Hh Genes--chromosome 19
  – H encodes, h is amorphic
<table>
<thead>
<tr>
<th>Gene</th>
<th>Glycosyltransferase</th>
<th>Immunodominant Sugar</th>
<th>Antigen</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>α-2-L-fucosyltransferase</td>
<td>L-fucose</td>
<td>H</td>
</tr>
<tr>
<td>A</td>
<td>α-3-N-acetylgalactosamyltransferase</td>
<td>N-acetyl-D-galactosamine</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>α-3-D-galactosyltransferase</td>
<td>D-galactose</td>
<td>B</td>
</tr>
</tbody>
</table>
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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
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RBC H ANTIGEN EXPRESSION

O > A₂ > B > A₂B > A₁ > A₁B

most H --------------> least H
What are the frequencies of ABO in the US Population?

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**THE ABO BLOOD GROUP SYSTEM**

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

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>White (%)</th>
<th>Black (%)</th>
<th>Mexican (%)</th>
<th>Asian (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>45</td>
<td>49</td>
<td>56</td>
<td>43</td>
</tr>
<tr>
<td>A₁</td>
<td>33</td>
<td>19</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td>A₂</td>
<td>8</td>
<td>8</td>
<td>6</td>
<td>Rare</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>19</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>A₁B</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>A₂B</td>
<td>1</td>
<td>1</td>
<td>Rare</td>
<td>Rare</td>
</tr>
</tbody>
</table>

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American Red Cross
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

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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
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?

<table>
<thead>
<tr>
<th>Anti-A Reagent</th>
<th>Anti-B Reagent</th>
<th>A1 cells Reagent</th>
<th>B cells Reagent</th>
<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+</td>
<td>0</td>
<td>1+</td>
<td>4+</td>
<td></td>
</tr>
</tbody>
</table>

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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<sub>1</sub> LECTIN
- TEST PATIENT’S SERUM FOR ANTI-A<sub>1</sub>
  - Test patient serum against A1, A2, B & O cells
  - Run Auto Control

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PATIENT RESULTS FROM ADDITIONAL TESTING

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

<table>
<thead>
<tr>
<th>Reagent Anti- sera</th>
<th>Reagent red cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>A, B</td>
<td>A1 LECTIN</td>
</tr>
<tr>
<td>A1</td>
<td>A2</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
</tr>
<tr>
<td>4+</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>4+</td>
</tr>
<tr>
<td>1+</td>
<td>0</td>
</tr>
<tr>
<td>4+</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>AUTO CONT</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
INTERPRETATION

• Patient A₂ with Anti-A₁
• Transfuse Group O packed Rbc’s

Note: Anti-A₁ is found in 1-8% of A₂ serum and in 22-35% of A₂B 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

- A2 group A red cells only react with Anti-A
- Approx. 19 to 20% of Group A persons belong to A2
- Approx. 500,000 antigen sites
- < 1% of Group A: other weaker subgroup
- Red cells contain fewer antigen sites
- A2 individuals have less transferase enzyme
- 1 to 8% produce anti-A1
- 22-35% produce anti-A1 in A2B persons
### MAIN SUBGROUPS OF A

<table>
<thead>
<tr>
<th>Phen</th>
<th>Reaction of cells with reagent antiserum</th>
<th>Reaction of serum with reagent cells</th>
<th>Saliva</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A,B</td>
</tr>
<tr>
<td>A₁</td>
<td>4+</td>
<td>0</td>
<td>4+</td>
</tr>
<tr>
<td>A₂</td>
<td>4+</td>
<td>0</td>
<td>4+</td>
</tr>
</tbody>
</table>

*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 A₁ or A₁B
  - *Bandeiraea simplicifolia*- B cells
  - *Ulex europaeus*- H specificity
In what order of decreasing strength would *Ulex europeaus* (*Anti-H*) react?

O > A₂ > B > A₂B > A₁ > A₁B
OTHER SUBGROUPS OF A

- **A₃ subgroup**
  - typically demonstrates 2+mf with Anti A and Anti A,B
  - sometimes produces Anti-A₁
- **Aₓ** demonstrates weak to negative reactions with Anti-A and usually 2+ reactions with Anti-A,B; usually makes Anti-A₁
- All other weaker subgroup, A specificity can only be demonstrated by absorption/elution procedures
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<th>Reaction of serum with reagent cells</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A,B</td>
</tr>
<tr>
<td>A₃</td>
<td>2+ mf</td>
<td>0</td>
<td>2+ mf</td>
</tr>
<tr>
<td>Aₘ</td>
<td>0/+/-</td>
<td>0</td>
<td>0/+/-</td>
</tr>
<tr>
<td>Aₓ</td>
<td>0/+/-</td>
<td>0</td>
<td>1+/2+</td>
</tr>
<tr>
<td>Aₑl</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

IF SE GENE IS INHERITED

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Subgroups of B: A Quick Review

<table>
<thead>
<tr>
<th>Phen</th>
<th>Reaction of cells with reagent antiserum</th>
<th>Reaction of serum with reagent cells</th>
<th>Saliva</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>A,B</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>4+</td>
<td>4+</td>
</tr>
<tr>
<td>B₃</td>
<td>0</td>
<td>1+ mf</td>
<td>2+ mf</td>
</tr>
<tr>
<td>Bₘ</td>
<td>0</td>
<td>0</td>
<td>0/ +/-</td>
</tr>
<tr>
<td>Bₓ</td>
<td>0</td>
<td>0/ +/-</td>
<td>0/ 1+</td>
</tr>
</tbody>
</table>

IF SE GENE IS INHERITED

The need is constant.
The gratification is instant.
Give blood.
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Where is the Discrepancy?

<table>
<thead>
<tr>
<th>Anti-A Reagent</th>
<th>Anti-B Reagent</th>
<th>A1 cells Reagent</th>
<th>B cells Reagent</th>
<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4+</td>
<td>W+</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
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 OR 15 MIN. AT 4°C
- ALWAYS RUN O CELLS AND AUTO CONTROL
Eighty-six year old patient with a bleeding ulcer and no history of transfusion

RESULTS OF RT INCUBATION

<table>
<thead>
<tr>
<th>FORWARD</th>
<th>REVERSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-A</td>
<td>Anti-B</td>
</tr>
<tr>
<td>A1 cells</td>
<td>B cells</td>
</tr>
<tr>
<td>O cells</td>
<td>Auto control</td>
</tr>
<tr>
<td>0</td>
<td>4+</td>
</tr>
<tr>
<td>3+</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
• Group B
• Elderly patient > 80 years old
• Transfuse Group B Rbc’s, if Antibody screen is negative
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<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4+</td>
<td>4+</td>
<td>2+</td>
<td></td>
</tr>
</tbody>
</table>
Cold Reacting Alloantibody
(i.e. Anti-M, Anti-P₁ 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**

<table>
<thead>
<tr>
<th></th>
<th>FORWARD</th>
<th></th>
<th>REVERSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>A,B</td>
<td>A1</td>
</tr>
<tr>
<td>0</td>
<td>4+</td>
<td>4+</td>
<td>4+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2+</td>
<td>2+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AUTO CONT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
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 alloabsorption using REST
- Repeat Reverse grouping using the absorbed serum or repeat reverse testing at 37°C
- Run panel on absorbed serum to detect any underlying cold or RT reacting alloantibodies

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Where is the Discrepancy?

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<th>B cell Reagent</th>
<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+</td>
<td>4+</td>
<td>2+</td>
<td>2+</td>
<td></td>
</tr>
</tbody>
</table>

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
<table>
<thead>
<tr>
<th>Reaction of red cells with reagent antiserum</th>
<th>Reaction of serum with reagent cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>4+</td>
<td>4+</td>
</tr>
</tbody>
</table>

**IS THIS:**

- Group AB--Cold autoantibody (anti-I)?
- Group AB--Cold autoantibody (anti-I) and cold alloantibody (anti-M, P<sub>1</sub>, Le<sup>a</sup>, Le<sup>b</sup>)?
- Group AB—Rouleaux?
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

<table>
<thead>
<tr>
<th>ANTI-A</th>
<th>ANTI-B</th>
<th>A1 CELLS</th>
<th>B CELLS</th>
<th>AUTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+</td>
<td>4+</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
INTERPRETATION

• GROUP AB
• TRANSFUSE GROUP AB
– Other Plasma Cell Dyscrasias
– Whartons jelly (newborn Cord samples)
– Dextran or hydroxy ethyl starch IV infusion
  (Crosslinks RBCs yielding pseudoagglutination)
Where is the Discrepancy?

<table>
<thead>
<tr>
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<th>Anti-B Reagent</th>
<th>A1 cell Reagent</th>
<th>B cell Reagent</th>
<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- PATIENT HISTORY IS IMPORTANT
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?

<table>
<thead>
<tr>
<th>Anti-A Reagent</th>
<th>Anti-B Reagent</th>
<th>A1 cells Reagent</th>
<th>B cells Reagent</th>
<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>2+mf</td>
<td>0</td>
<td>0</td>
<td>4+</td>
<td></td>
</tr>
</tbody>
</table>
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 A₃ subgroup that exhibits characteristic mixed-field agglutination

<table>
<thead>
<tr>
<th>Anti-A Reagent</th>
<th>Anti-B Reagent</th>
<th>A₁ cells Reagent</th>
<th>B cells Reagent</th>
<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>2+mf</td>
<td>0</td>
<td>0</td>
<td>4+</td>
<td></td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Reagent Anti-sera</th>
<th>Reagent red cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A1</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>A,B</td>
<td>0</td>
</tr>
<tr>
<td>H LECTIN</td>
<td>4+</td>
</tr>
<tr>
<td>AA</td>
<td>DAT</td>
</tr>
<tr>
<td>BB</td>
<td>AUTO CONT</td>
</tr>
<tr>
<td>2+mf</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2+mf</td>
<td>3+</td>
</tr>
<tr>
<td>3+</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

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• A₃ Subgroup
• Transfuse Group O packed Rbc’s

This case shows the importance of transfusion history.
Where is the Discrepancy?

<table>
<thead>
<tr>
<th>Anti-A Reagent</th>
<th>Anti-B Reagent</th>
<th>A1 cell Reagent</th>
<th>B cell Reagent</th>
<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+</td>
<td>1+</td>
<td>0</td>
<td>4+</td>
<td></td>
</tr>
</tbody>
</table>

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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

<table>
<thead>
<tr>
<th>ANTI-A</th>
<th>ANTI-B</th>
<th>A1 CELLS</th>
<th>B CELLS</th>
<th>AUTO CONT</th>
<th>BS-1 lectin</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+</td>
<td>0</td>
<td>0</td>
<td>4+</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- 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?

<table>
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<tr>
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<th>A1 cell Reagent</th>
<th>B cell Reagent</th>
<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>4+</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>ANTI-A</th>
<th>ANTI-B</th>
<th>A1 CELLS</th>
<th>B CELLS</th>
<th>INT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3+</td>
<td>4+</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
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
The need is constant.
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Where is the Discrepancy?

<table>
<thead>
<tr>
<th>Anti-A Reagent</th>
<th>Anti-B Reagent</th>
<th>A1 cell Reagent</th>
<th>B cell Reagent</th>
<th>Interpret</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4+mf</td>
<td>3+</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

POSSIBILITIES?

- GROUP B PREVIOUSLY TRANSFUSED WITH GROUP O
- GROUP B WITH O BMT
- GROUP B EXCHANGE TRANSFUSION WITH GROUP O
- B₃ SUBGROUP

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RESOLUTION

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

<table>
<thead>
<tr>
<th>FORWARD</th>
<th>REVERSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>H</td>
</tr>
<tr>
<td>0</td>
<td>4+mf</td>
</tr>
<tr>
<td>3+</td>
<td>4+</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

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• 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

<table>
<thead>
<tr>
<th></th>
<th>Anti-A Reagent</th>
<th>Anti-B Reagent</th>
<th>Anti-A,B</th>
<th>A1 cell</th>
<th>B cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin 1</td>
<td>0</td>
<td>2+mf</td>
<td>2+mf</td>
<td>4+</td>
<td>0</td>
</tr>
<tr>
<td>Twin 2</td>
<td>0</td>
<td>+wk</td>
<td>+wk</td>
<td>4+</td>
<td>0</td>
</tr>
</tbody>
</table>

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

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