Case Study - Double Volume Exchange Transfusion

Dr Lincy Jacob, Consultant
Dr L H Hiranandani Hospital Blood Bank
Case History

- Blood sample of mother and newborn was received from a local Pediatric nursing home on 8/1/12

- Requirement:
  Two units of Whole Blood to be cross matched and issued for baby
# Test Results

- **Baby’s Blood Group**  
  (Column Agglutination Technology)

<table>
<thead>
<tr>
<th>Pat. ID</th>
<th>Anti A</th>
<th>Anti B</th>
<th>Anti AB</th>
<th>Anti D</th>
<th>A1 cell</th>
<th>B cell</th>
<th>O cell</th>
<th>Interp</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/o Mrs. X</td>
<td>0</td>
<td>4+</td>
<td>3+</td>
<td>4+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>B Positive</td>
</tr>
</tbody>
</table>


## Test Results

### Mother’s Blood Group
*(Column Agglutination Technology)*

<table>
<thead>
<tr>
<th>Pat. ID</th>
<th>Anti A</th>
<th>Anti B</th>
<th>Anti AB</th>
<th>Anti D</th>
<th>Weak D</th>
<th>A1 cell</th>
<th>B cell</th>
<th>O cell</th>
<th>Intrp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mrs. X</td>
<td>0</td>
<td>4+</td>
<td>3+</td>
<td>0</td>
<td>Neg</td>
<td>4+</td>
<td>4+</td>
<td>4+</td>
<td>B Neg</td>
</tr>
</tbody>
</table>


Mother’s Blood Group
Antibodies

Present

Not present
Additional tests

- Mother’s ICT Positive (4+)
- Baby’s ICT and DCT Positive (4+)
Antibody Screen

- Antibody screen using 3 cells was performed- SC 1 & 2 was positive
Probable antibodies

- Rh (D), Kidd (Jkª)
Interpretation

Hemolytic Disease of Newborn
Previous History

- Mother’s third pregnancy
- First pregnancy uneventful
- Second delivery newborn dies within a week after birth
- Not clear if she was given Rh Ig during second pregnancy
History

- Third delivery after gap of 2 years
  - Normal full term
- Birth weight -3 kg
- Newborn referred to Neonatal intensive care on 3rd day
- Newborn was lethargic, not taking feeds
- Icteric, pale. S.Bil. >28mg/dl
- Requiring Whole blood for exchange transfusion
## Test Results

- **Cross match** *(Coombs card)*

<table>
<thead>
<tr>
<th>Pat. ID</th>
<th>Donor Bld.Gp</th>
<th>Major RT (Sal)</th>
<th>Major Coombs</th>
<th>Minor (Reconstituted Plasma)</th>
<th>Interp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mrs X</td>
<td>O Neg (PC)</td>
<td>Comp</td>
<td>Comp</td>
<td>AB plasma</td>
<td>Comp.</td>
</tr>
<tr>
<td>B/o Mrs X</td>
<td>O Neg (PC)</td>
<td>Comp</td>
<td>Comp</td>
<td>AB plasma</td>
<td>Comp</td>
</tr>
</tbody>
</table>
DVET- First Day

- Two unit of fresh (<5 days old) O Neg Packed Red Blood cells reconstituted with AB plasma was issued on First day for DVET

- S. Bilirubin-28mg/dl

- Baby’s DCT was 4+
DVET- Second day

- Second day request came for 2 more units of WB
  - S. Bilirubin was 24mg/dl
  - Baby’s DCT – Weak reaction

Two unit of fresh (<5 days old) O Neg Packed Red Blood cells reconstituted with AB plasma was issued on Second day for DVET
DVET- Third Day

- Third day request came for 2 more units of WB
  - S. Bilirubin gone up to 32mg/dl
  - Baby’s DCT – Negative

Two unit of fresh (<5 days old) O Neg Packed Red Blood cells reconstituted with AB plasma was issued on third day for DVET
Fourth Day

- S. Bilirubin gone up to 38mg/dl
  - Repeat S. Bil levels from Second lab - 28mg/dl

- Decided to refrain from further transfusion
  - Double surface phototherapy over next few days and monitoring of bilirubin levels

- Bilirubin levels dropped below 20mg/dl
Probable Cause

- Sepsis
- Movement of unconjugated bilirubin from Extravascular to intravascular space following exchange transfusion
- Laboratory error
Probable Cause

- Reconstituted blood-
  The mean pre-ECT haematocrit of exchange transfused patients with whole blood and reconstituted blood was compatible. Although the mean post-ECT haematocrit in the reconstituted group was higher (39.74 +/- 5.65 versus 38.21 +/- 3.59), this difference was not significant (p is 0.15).

ECT with either reconstituted or fresh whole blood is an efficient and safe method for reducing hyperbilirubinaemia (Exchange transfusion in neonatal hyperbilirubinaemia: a comparison between citrated whole blood and reconstituted blood-Gharehbaghi M M, Hosseinpour S S; Sing. Med J ’10)
Single versus double volume exchange transfusion

- This study compared single and double volume exchange transfusion in jaundice due to ABO hemolytic jaundice. The study found no significant difference in bilirubin levels following exchange. Based on the available data, there is insufficient evidence to support or refute the use of single volume exchange transfusion as opposed to double volume exchange transfusion in jaundiced newborns.

Thayyil S, Cambridge, UK, 2006
Hemolytic Disease of Newborn (HDN)

- Destruction of the RBCs of the fetus and newborn by antibodies produced by the mother

- IgG antibodies are involved since it can cross the placenta

\[
\text{Mother's antibodies} + \text{Fetal RBC} = \text{destruction}
\]
During delivery, Rh antigens enter mother's circulation through breaks in the placenta. Mother makes anti-Rh antibodies.

(a) First pregnancy

Mother has anti-Rh antibodies. Anti-Rh antibodies cross the placenta and destroy fetal blood cells.

(b) Subsequent pregnancy

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Initial Therapy - Phototherapy
Phototherapy

- Phototherapy is used to decrease bilirubin levels to prevent the elevation of unconjugated bilirubin.
- Light source is positioned at 50 cm above the infant.
- Wavelengths of 420-475 nm used to break down unconjugated bilirubin to water-soluble product lumirubin via photooxidation through the skin.
- This product is eliminated in bile and urine.
- Phototherapy initiated when bilirubin value approaches 50% of the birth weight value (e.g., 4 mg/dL in an 800-g infant).
Exchange Transfusion

- If the level of bilirubin does not decrease with phototherapy, exchange transfusion is the next therapeutic option.
  - SVET-63% TBV removed
  - DVET-86% TBV removed
Exchange Transfusion

- Single Volume Exchange Transfusion (SVET) or Double Volume Exchange Transfusion (DVET) is considered if the level of bilirubin approaches 10 mg/dL (or 10 mg/dL/kg).

- In healthy term infants, exchange transfusion is not considered until the bilirubin level greater than 25 mg/dL on the third day and the infant has failed a trial of phototherapy.

- In exchange transfusions, almost 85-90% of the infant’s blood is replaced with donor blood.

- If correctly performed, (push and pull method) it removes about 60% of bilirubin from the plasma, resulting in a clearance of about 30-40% of the total bilirubin.
# Complications

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Problems with Donor blood</th>
<th>Effect on infant</th>
<th>Prevention/Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cold blood</td>
<td>Hypothermia</td>
<td>Warm to body temp</td>
</tr>
<tr>
<td>2.</td>
<td>High K+</td>
<td>Hyperkalemia</td>
<td>Fresh blood&lt;5 days</td>
</tr>
<tr>
<td>3.</td>
<td>Low Platelets (reconstituted)</td>
<td>Thrombocytopenia</td>
<td>Platelet transfusion</td>
</tr>
<tr>
<td>4.</td>
<td>Citrate in anticoagulant</td>
<td>Hypocalcemia</td>
<td>Ca Gluconate</td>
</tr>
</tbody>
</table>
Prognosis

- Generally very good

- Prior to the introduction of exchange transfusion, infants with severe rhesus hemolytic disease had a 35-40% mortality, with a 90% risk of severe neurological damage (Kernicterus) among survivors.

- Reduction in mortality to 20% and reduction in adverse neurological outcome to 30% was observed following the introduction of double volume exchange transfusion.
Prevention

- RhIg is given to the mother to prevent immunization to the D antigen
  - RhIg (1 dose) is given at 28 weeks gestation
  - RhIg attaches to fetal RBCs in maternal circulation and are removed in maternal spleen; this prevents alloimmunization by mother
  - May cause a positive DAT in newborn
Prevention

- Another dose of RhIg should be given to the mother within 72 hours of delivery (even if stillborn)
  - Mother should be D negative
  - Newborn should be D positive or weak D
  - About 10% of the original dose will be present at birth, so it’s important to give another dose to prevent immunization
Summary

- Newborn baby received DVET over 3 consecutive day starting from the 3rd day of life
- Bilirubin levels did not decrease significantly even after repeated DVET
- Newborn had sepsis and was on antibiotic treatment
- Repeat testing performed at alternate laboratory
- Refrained from further transfusions and with repeated phototherapy brought down bilirubin levels
- Infant was discharged after 10 days, doing well at last follow up visit
Thank You