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INTRODUCTION

- Definition & Significance Of Hemolysis
- Discuss Practice Patterns
- Determine Causes
- Propose Improvements
- Conclusions
Hemolysis is the disruption of the blood cell membrane with the release of the blood cell contents into the surrounding fluid.
SOME IN VIVO HEMOLYSIS CAUSES

- Hemolytic Transfusion Rx, Autoimmune Warm Ab
- Hereditary Spherocytosis, G6PD Def, Sickle Cell
- Hemolytic Transfusion Rx, Autoimmune Warm Ab
- Anti-malarials, Aspirin, Chloramphenicol
- Malaria, Clostridia, DIC
- Burns, Liver & Renal Disease, PNH
- March Hemoglobinuria, Prosthetic Heart Valves
PHLEBOTOMY RELATED CAUSES

- Catheter IV Collection
- Drawn From Hematoma
- Capillary Collection
- Phlebotomy Equipment
- Phlebotomy Antiseptic
- Tourniquet Time

- Location of Stick
- No Mixing In Tube
- Vigorous Mixing In Tube
- Traumatic Draw
- Tube Under Filling
- Syringe Transfer

PRACTICE PATTERNS OF HEMOLYSIS
CAP QUALITY PRACTICES COMMITTEE STUDY

Q-Probes Format
CAP Chemistry Resource Committee Assistance
7 CAP Chemistry Survey Participants
On-Line Questionnaire
28 Multiple Choice Questions
7 “Other, Please List” Questions
846 Participants
LABORATORY OVERALL HEMOLYSIS RATE (%)

<table>
<thead>
<tr>
<th>Laboratory Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.0%</td>
<td>36%</td>
</tr>
<tr>
<td>1.0-2.9%</td>
<td>35%</td>
</tr>
<tr>
<td>3.0-5.9%</td>
<td>15%</td>
</tr>
<tr>
<td>6.0-14.9%</td>
<td>4%</td>
</tr>
<tr>
<td>&gt;=15%</td>
<td>1%</td>
</tr>
<tr>
<td>Unsure</td>
<td>9%</td>
</tr>
<tr>
<td>Parameter</td>
<td>% Yes</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Hemolysis visually graded compared to a picture</td>
<td>40</td>
</tr>
<tr>
<td>Visual grading evaluated by competency assessment</td>
<td>18</td>
</tr>
<tr>
<td>Manual procedures identify hemolysis in difficult cases</td>
<td>8</td>
</tr>
<tr>
<td>Able to send automated hemolysis flags to med record</td>
<td>36</td>
</tr>
<tr>
<td>Used automated result verification primary chem analyzer</td>
<td>32</td>
</tr>
<tr>
<td>Same hemolysis scale all analytes primary chem analyzer</td>
<td>81</td>
</tr>
<tr>
<td>Same hemolysis scale primary chem &amp; IA analyzer</td>
<td>70</td>
</tr>
<tr>
<td>Same hemolysis scale primary &amp; backup chem analyzer</td>
<td>74</td>
</tr>
<tr>
<td>Systematically/regularly monitors hemolyzed specimens</td>
<td>47</td>
</tr>
</tbody>
</table>
HEMOLYSIS SCALES USED 710 LABS

- Both visual and instrument scale: 41%
- Visual scale only: 48%
- Instrument scale only: 11%
HEMOLYSIS REJECTION PRACTICES

- All specimens rejected for any hemolysis, 8%
- No specimens rejected for any hemolysis, 4%
- Some specimens rejected based on hemolysis level, 88%
21/69 MOST COMMONLY USED HEMOLYSIS DESCRIPTIVE TERMS
USE OF 20 CUTOFF HEMOLYSIS TERMS

Graph showing the use of different hemolysis terms, with 'Gross' being the most frequently used term.
ANALYTE SPECIFIC HEMOLYSIS POLICIES

- Lactate Dehydrogenase (LD): 69%
- Glucose: 55%
- Potassium: 85%

- Written Policy of Specimen Rejection
- Standardized Reports Between Primary & Secondary Analyzers
ATTEMPTED TO VALIDATE HEMOLYSIS FOR ANALYTES

- LD: 23%
- Glucose: 24%
- Potassium: 29%
- Any: 30%
CORRECTIVE ACTION DURING PAST YEAR

- Provided information for physicians: 19%
- Established quality improvement team between laboratory and problem locations: 37%
- Provided ongoing training for phlebotomists: 53%
- Troubleshooted outliers & discussed hemolysis avoidance with phlebotomists: 55%
- Collected hemolysis data & distributed to leadership where hemolysis has occurred: 57%

Percent of Total: 0% - 60%
LACK OF SUCCESS IN HEMOLYSIS REDUCTION (N=567)

- Try to reduce & have made slow progress: 50%
- Concerned about % but do not know how to reduce: 10%
- Continue to try to reduce - nothing helps: 8%
- Given up on reducing as nothing helps: 2%
- Now ignore hemolysis: 0.3%
- Other: 30%
PHLEBOTOMY RELATED CAUSES

Catheter IV Collection
Drawn From Hematoma
Capillary Collection
Phlebotomy Equipment
Phlebotomy Antiseptic
Tourniquet Time

Location of Stick
No Mixing In Tube
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Traumatic Draw
Tube Under Filling
Syringe Transfer

WHOLE BLOOD HEMOLYSIS DETECTION

- K⁺ elevated, centrifuged, visually inspected: 3%
- K⁺ elevated, other tubes evaluated: 3%
- After analyses centrifuged, visually inspected: 21%
- After analyses stored, visually inspected: 10%
- Not Determined: 56%
CASE REPORT
Ismail et al BMJ 330:949, 2005

40 Year Old Woman Admitted –Dx SLE
5 Days Vomiting, Diarrhea, Weakness
Hb 8.9 g/dl, WBC 6.1 X10^9
BUN 87 mg/dl Creatinine 4.8 mg/dl
Blood Smear –Diffuse Fragmented Cells Consistent With Microhemangiopathic Hemolytic Anemia
Potassium Cancelled-Hemolyzed
CASE REPORT CONTINUED

Dx-Hemolytic Uremic Syndrome & Acute Renal Failure
Treated Aggressively, & Planned To Transfer To Dialysis Next Day
Cardiac Arrest & Died
POST MORTEM ? K
If Known, Immediate Dialysis?
RECENT INSTRUMENTATION ADVANCES

• Measure Hemolysis
• Download Hemolysis To LIS
• Provide Extensive Hemolysis Evaluations
• Allow Unique Hemolysis Flag By Analyte
• Hemolysis Measurements FDA Approved
COST OF HEMOLYSIS

- $203,037 /Yr
- Reduced Hemolysis 19.8% To 4.9%
- Singapore General Hospital ED
- 200 ‘Lyes & Bun/Day
- $18.67/Test

COST OF HEMOLYSIS
• ICU/DAY
• Hospital Charge/Day
SAME HEMOLYSIS FLAGS AS LIPEMIA OR ICTERUS

- Lipemia: 53%, 58%, 61%, 37%
- Icterus: 54%, 55%, 64%, 36%

Diagrams showing the percentage of hemolysis flags corresponding to LD, Glucose, Potassium, and Other categories.
AIDS FOR IMPROVEMENT
VALIDITY OF DATA ON CAUSES

- Many Studies By Nursing Personnel
- Difficulty In Controlling Variables
- Unaware Lab vs Nursing Phlebotomists
- Some Data Conflicting
- Need For Published Studies
## Table 4
Specimen hemolysis by group—cross tabulation

<table>
<thead>
<tr>
<th>Group</th>
<th>No</th>
<th>Yes</th>
<th>% hemolysis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venipuncture</td>
<td>354</td>
<td>1</td>
<td>&lt;1</td>
<td>355</td>
</tr>
<tr>
<td>Intravenous catheter</td>
<td>470</td>
<td>28</td>
<td>5.62</td>
<td>498</td>
</tr>
<tr>
<td>Total</td>
<td>824</td>
<td>29</td>
<td></td>
<td>853</td>
</tr>
</tbody>
</table>

FIVE IMPROVEMENT SUGGESTIONS

Do Not Reject Hemolyzed Specimens
Develop Interdepartmental Team(s)
Choose Instruments That Quantitate Hemolysis
Monitor & Share Successes With Administration
Select Aids For Improvement
CONCLUSIONS

• Definition & Significance Of Hemolysis
• Discussed Clinical Laboratory Practice Patterns
• Established Causes
• Provided Suggestions For Improvements