Comparison of POC ACT Test Systems in Different Clinical Settings in a Large Academic Medical Center

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UMass Memorial Medical Center
Worcester, MA

Vascular Surgery
Cardiac Catheterization
Interventional Radiology
Cardiac Surgery
Considerations during heparin therapy management include:
- Manufacturer/lot heparin activity
- Patient sensitivity to heparin
- Target patient coagulation status
- Activated clotting time (ACT) measurement test system

Excessive or life-threatening bleeding
Activated Clotting Time (ACT)

- Functional assay used to monitor heparin inhibitory effect
- Measures the time required for activation of the intrinsic and common pathways of the coagulation cascade
- Numerous point of care ACT testing devices available, including but not limited to:
Activated Clotting Time (ACT)

- No gold standard ACT measurement test system exists and results may not be interchangeable between test systems

Whole blood

ACT Test Device

- Many devices commercially available

Surface Activator

- Kaolin
- Celite
- Glass beads
- Other

Testing Mode

- Prewarm
- Nonprewarm

Detection Method

- Mechanical clot detection
- Amperometric detection of electroactive compound ("clot time")
UMass Memorial Medical Center

ACT Test Systems

Vascular Surgery
ISTAT Prewarm Celite

Cardiac Catheterization
ISTAT Nonprewarm Celite

New POCT request:
ACTPlus Prewarm Kaolin

Interventional Radiology
ISTAT Prewarm Celite

Cardiac Surgery
HMSPlus Prewarm Kaolin
Study Design

Sample Selection:
41 Venous Whole Blood Samples

17 Cardiac Catheterization Patients (17 WB samples)
5 Cardiopulmonary Bypass Patients (20 WB samples)
2 Vascular Surgery Patients (4 WB samples)

ACT Measurement Test Systems
Duplicate measurements per test system (n=410)

Reference Method
HMS Plus
Prewarm
Kaolin
Mechanical
ISTAT
Prewarm
Celite
Amperometric
ISTAT
NonPrewarm
Celite
Amperometric
ACT Plus
Prewarm
Kaolin
Mechanical
ISTAT
Prewarm
Kaolin
Amperometric

Systems In-Use
Test Systems
ACT: Test System Reproducibility

<table>
<thead>
<tr>
<th>Device</th>
<th>Mode</th>
<th>Activator</th>
<th>Method Duplicate 1 - Duplicate 2 ACT Mean (± SD; sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>100-299 sec</td>
</tr>
<tr>
<td>HMSPlus</td>
<td>Prewarm</td>
<td>Kaolin</td>
<td>-0.3 (± 6.6)</td>
</tr>
<tr>
<td>iSTAT</td>
<td>Prewarm</td>
<td>Celite</td>
<td>-2.4 (± 4.7)</td>
</tr>
<tr>
<td>iSTAT</td>
<td>Non-prewarm</td>
<td>Celite</td>
<td>3.5 (± 5.1)</td>
</tr>
<tr>
<td>ACTPlus</td>
<td>Prewarm</td>
<td>Kaolin</td>
<td>1.4 (± 9.9)</td>
</tr>
<tr>
<td>iSTAT</td>
<td>Prewarm</td>
<td>Kaolin</td>
<td>0.2 (± 6.8)</td>
</tr>
</tbody>
</table>
ACT: Linear Regression Analyses

- **ISTAT Prewarm Celite ACT (Sec)**
  - \( R^2 = 0.9646 \)

- **ISTAT Nonprewarm Celite ACT (Sec)**
  - \( R^2 = 0.9525 \)

- **ISTAT Prewarm Kaolin ACT (Sec)**
  - \( R^2 = 0.9802 \)

- **ISTAT Nonprewarm Kaolin ACT (Sec)**
  - \( R^2 = 0.9373 \)
### Moderate Range ACT: Bland Altman Analyses

#### Graphs:
- **HMSPlus ACT (Sec)**: Two scatter plots showing the relationship between absolute difference and HMSPlus ACT (Sec).
- **Test Method - HMSPlus**:
  - **iSTAT Prewarm Celite**: ACT Mean (± SD) Difference (sec) = -14 (± 16)
  - **iSTAT Non-prewarm Celite**: ACT Mean (± SD) Difference (sec) = 4.2 (± 17)
  - **ACTPlus Prewarm Kaolin**: ACT Mean (± SD) Difference (sec) = -10 (± 19)
  - **iSTAT Prewarm Kaolin**: ACT Mean (± SD) Difference (sec) = -12 (± 18)

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<th>Test Method - HMSPlus</th>
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<tr>
<td>iSTAT</td>
<td>Prewarm</td>
<td>Celite</td>
<td>ACT Mean (± SD) Difference (sec) = -14 (± 16)</td>
</tr>
<tr>
<td>iSTAT</td>
<td>Non-prewarm</td>
<td>Celite</td>
<td>ACT Mean (± SD) Difference (sec) = 4.2 (± 17)</td>
</tr>
<tr>
<td>ACTPlus</td>
<td>Prewarm</td>
<td>Kaolin</td>
<td>ACT Mean (± SD) Difference (sec) = -10 (± 19)</td>
</tr>
<tr>
<td>iSTAT</td>
<td>Prewarm</td>
<td>Kaolin</td>
<td>ACT Mean (± SD) Difference (sec) = -12 (± 18)</td>
</tr>
</tbody>
</table>
High Range ACT: Bland Altman Analyses

<table>
<thead>
<tr>
<th>Device</th>
<th>Mode</th>
<th>Activator</th>
<th>ACT Mean (± SD)</th>
<th>Difference (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>iSTAT</td>
<td>Prewarm</td>
<td>Celite</td>
<td>-27 (± 57)</td>
<td></td>
</tr>
<tr>
<td>iSTAT</td>
<td>Non-prewarm</td>
<td>Celite</td>
<td>2.0 (± 69)</td>
<td></td>
</tr>
<tr>
<td>ACTPlus</td>
<td>Prewarm</td>
<td>Kaolin</td>
<td>3.5 (± 45)</td>
<td></td>
</tr>
<tr>
<td>iSTAT</td>
<td>Prewarm</td>
<td>Kaolin</td>
<td>-26 (± 80)</td>
<td></td>
</tr>
</tbody>
</table>
UMass ACT Testing Practices:

Win-Win!

Vascular Surgery
HMSPlus Prewarm Kaolin

Cardiac Catheterization
ISTAT Nonprewarm Celite

Interventional Radiology
ISTAT Nonprewarm Celite

Cardiac Surgery
HMSPlus Prewarm Kaolin
Summary / Conclusions

• Many variables to consider with ACT test systems
  • Testing device
  • Surface activator type
  • Test calibration mode
  • Detection method

• No gold standard ACT test system exists

• Comparison studies that span the ACT range used in clinical practice are needed when considering a change in ACT test system

• The optimal ACT measurement test system depends on the analytical performance characteristics for a given ACT target range and clinical concordance of ACT values
Acknowledgements

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Heparin Therapy

- Anti-coagulation therapy to prevent thrombosis
- Heparin indirectly inhibits factors IIa (thrombin) and Xa through binding and potentiating anti-thrombin activity
Heparin Effect on the Coagulation Cascade

- Heparin-anti-thrombin complex inhibits coagulation factors in the intrinsic and common pathways to suppress clot formation.

http://labtestsonline.org/assets/documents/Physiologic_Coag_Cascade.pdf; Accessed 09/01/14