Aarhus University Hospital
Validation of Tempus600® Transport system for blood tube samples

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Abstract

Tempus600®
Tempus600®[1] is a transport system dedicated for transporting blood sample tubes. After drawing the blood sample, the tubes are placed in the Tempus600® rack and loaded in the Tempus600® launch unit. The Tempus600® system was installed at Aarhus University Hospital Noerrebrogade in August 2012. The launch unit is placed in the emergency department and the point of delivery is in the laboratory, Department of Clinical Biochemistry. The transport pipes ø25, placed above the lowered ceilings. The system is the first of its kind transporting blood samples tubes covering a distance of 135 meters with a height difference of 3 floors (13 meters) in less than 30 seconds.

Daily use
The blood tube sample transport system is handled by the biomedical laboratory technicians with the aim of securing fast delivery of blood samples of acute care patients mainly from the emergency department, as well as from the medical and surgical preadmission assessment departments.

Method and materials

Patients
50 patients for chemistry and coagulation analysis and 49 patients for hematology analysis were included in the validation.

The samples were drawn in the daytime from 21st – 28th August 2012. The patients were randomly chosen among patients in the department’s phlebotomy clinic.

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Validation
The Tempus600® system was examined with a view to assess to what extend the blood samples were affected by the transport. Physical impact, such as shaking, acceleration, speed or G-forces, might destroy the blood cells, especially erythrocytes (the red blood cells) and give an incorrect test result[2]. 2 blood samples were drawn from each patient. One sample tube was sent by routine courier transport to the laboratory (reference) and the second one was sent with Tempus600®. Both sample batches were centrifuged as soon as possible upon arrival in the laboratory.

Blood analysis
The blood samples were tested for:

Biochemical tests (Roche Cobas6000 Analyzer)
- Plasma Potassium and Lactate dehydrogenase (LD) tests are influenced by erythrocyte destruction. The concentration of potassium and LD in erythrocytes are higher compared to content in plasma.
- Plasma Alkaline phosphatase has shown to be ascending by haemolysis [3]
- Haemolytic index (H-index) determines the level of free haemoglobin in plasma, as a measurement for erythrocyte destruction. We have established limits for allowable haemolysis in the samples (changes < 10%), expressed by H-index. H-index limits are <100 for Potassium, <15 for Lactate dehydrogenase and <200 for Alkaline phosphatase.

Additional tests:

Coagulation tests (Stago STA-R analyzer)
- International Normalized Ratio (INR) and Activated Partial Tromboplastin Time (APTT)

Haematology test (Sysmex XE2100 analyzer)
- Leucocyte, Lymphocyte and Trombocyte,

Blood collection
Becton Dickinson tubes were used for blood collection
- Lithium heparin plasma catalog number. 368884 (biochemical test)
- Sodium citrate plasma catalog number. 363048 (INR, APTT)
- EDTA plasma catalog number 368860 (leucocyt, lymphocyte, trombocyte)

Statistical procedures
We used Microsoft Excel 2003 with additional Analyze-IT program, for all statistical analyses. Comparisons of Tempus600® and routine courier transport (reference) were done by using Bland-Altman difference plots (figure 1). Two-sided F- and T-test were done to test for significant differences of Tempus600® and reference data. When p-value is less than the significance level 0.05, the result is said to be statistically significant. See below table.

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Results

Table

<table>
<thead>
<tr>
<th>Unit</th>
<th>Tempus mean</th>
<th>Reference mean</th>
<th>bias</th>
<th>bias %</th>
<th>p-value</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>3,96</td>
<td>3,95</td>
<td>0,01</td>
<td>0,20%</td>
<td>0,90</td>
<td>50</td>
</tr>
<tr>
<td>LD</td>
<td>172,04</td>
<td>172,70</td>
<td>4,34</td>
<td>2,85%</td>
<td>0,53</td>
<td>50</td>
</tr>
<tr>
<td>Alkaline phosphatase</td>
<td>U/l 100,54</td>
<td>U/l 100,90</td>
<td>-0,36</td>
<td>-0,51%</td>
<td>0,99</td>
<td>50</td>
</tr>
<tr>
<td>H-index</td>
<td>4,58</td>
<td>2,24</td>
<td>2,34</td>
<td>69,62%</td>
<td>2,6x10^-5</td>
<td>50</td>
</tr>
<tr>
<td>INR</td>
<td>* 1,01</td>
<td>1,02</td>
<td>-0,005</td>
<td>-0,38%</td>
<td>0,92</td>
<td>50</td>
</tr>
<tr>
<td>APTT</td>
<td>s 31,33</td>
<td>31,33</td>
<td>-0,07</td>
<td>-0,25%</td>
<td>0,95</td>
<td>50</td>
</tr>
<tr>
<td>Leucocyte</td>
<td>10^9/l 7,26</td>
<td>7,23</td>
<td>0,04</td>
<td>0,11%</td>
<td>0,96</td>
<td>49</td>
</tr>
<tr>
<td>Lymphocyte</td>
<td>10^9/l 2,09</td>
<td>2,08</td>
<td>0,02</td>
<td>0,57%</td>
<td>0,97</td>
<td>49</td>
</tr>
<tr>
<td>Trombocyte</td>
<td>10^9/l 245,16</td>
<td>247,14</td>
<td>-1,98</td>
<td>0,90%</td>
<td>0,91</td>
<td>49</td>
</tr>
</tbody>
</table>

* ratio

Comments

H-index
Significant differences were found between routine transport and Tempus600® transport for H-index (p-value <0,05). When transporting the blood sample tubes using Tempus600® the H-index went up approx. 2,3 mg/dl compared to routine transport (min. -7 to max. 10 mg/dl). Overall the higher values for the H-index were acceptable for the blood sample testing.

Other analyses
For the other analyses no significant difference was noticed between routine transport and Tempus600® transport. (p-values > 0,05)

Conclusion
The validation of Tempus600® has shown very satisfying results. Based on the findings it is recommended using Tempus600® for transporting blood sample tubes.

References
1. www.Tempus600.com
Figure 1: Bland-Altman difference plots

Biochemical test

H-index

Plasma Potassium
Plasma Alkaline Phosphatase

Plasma Lactate Dehydrogenase
Coagulation tests

APTT

INR

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Heamatology test

Leucocyte

Lymphocyte

Trombocyte