Evaluation of a fast single sample pneumatic tube system

Juliane Suchsland[1], Anne Greiser[1], Thomas Streichert[2], Benjamin Otto[3], Stefan Bollmann[1], Matthias Nauck[1], Astrid Petersmann[1]

[1]Institute of Clinical Chemistry and Laboratory Medicine, University Medicine Greifswald; [2]Institute of Clinical Chemistry, Medical Faculty, University of Cologne; [3]I.Department of Internal Medicine, University Medical Center, Hamburg-Eppendorf

Background: Pneumatic tube systems (PTS) can reduce transport time of blood samples. A new Danish PTS (TEMPUS600®) which does not require packing and unpacking of samples, transports samples with 10 m/s. It allows sending of samples directly into the bulk loader of a laboratory automation system. The quality of samples can be influenced during transport and may result in preanalytical errors like hemolysis and increase of analyte concentrations such as potassium. With mini data loggers, which measure temperature, humidity, pressure and acceleration, transport conditions can be described [1]. We investigated influences of TEMPUS600® on the quality of samples.

METHODS

Duplicate blood samples of 20 volunteers were drawn. One set of samples was transported by courier and the other by PTS (TEMPUS600®; TIMEDICO A/S; Bording, Denmark). During transport, a mini data logger (Fig. 2) (MSR145®; CiK Solutions GmbH; Karlsruhe, Germany) continuously measured temperature and accelerations. After transport clinical chemistry, hematology and coagulation parameters were measured, compared and the corresponding g-forces were calculated.

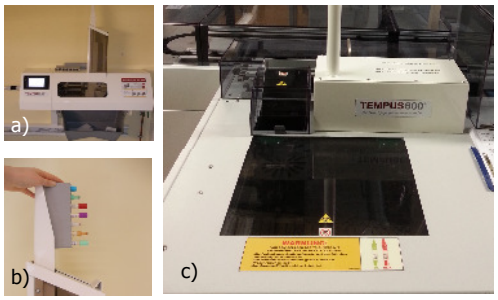

Fig.1:

a) Tempus600® station on the ward

b) rack with samples

c) PTS ending in the bulk loader of the laboratory auto-mation system

RESULTS and DISCUSSION

Though samples in PTS were subject to maximum accelerations of ~18 g compared to ~6 g of courier transport (Fig. 3), the cumulated forces (vector sum; [1]) did not reveal relevant differences between the conventional and single sample PTS. Medians of results differed less than 10% for all investigated analytes (Tab. 1). Mean relative differences of medians for LDH (lactate dehydrogenase) and free Hb (hemoglobin) were 8.1% and 6.3% respectively, both showing lower values in PTS samples. There was no difference between mean relative differences for potassium.

Fig. 2: Mini data logger in protective case, without protective case, empty tube and logger in tube

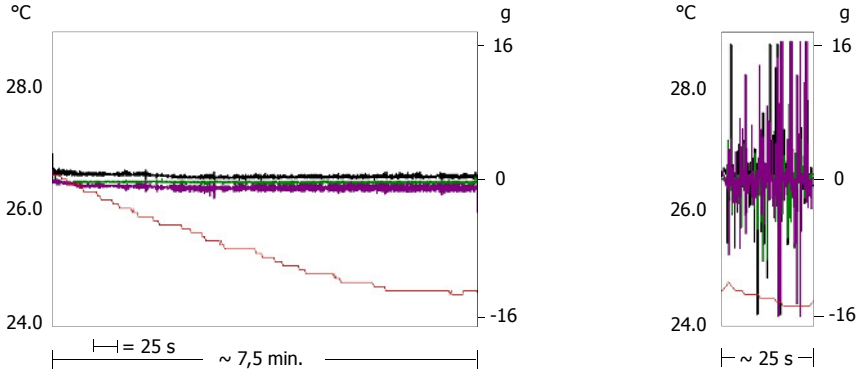

Fig. 3: G – forces acting on samples during transport by courier (left) and by PTS (right); black, green and purple lines represent g – forces in x -, y – and z – direction, respectively; red line represents temperature in °C

	median courier	median PTS	mean relative difference [%]
LDH [µkatal/l]	3.04	2.79	8.1
free hemoglobin [µmol/l]	16	15	6.3
potassium [mmol/l]	3.9	3.9	0.0
sodium [mmol/l]	138.0	138.0	0.0
creatinine [µmol/l]	71.0	69.0	2.8
glucose [mmol/l]	5.4	5.1	5.6
hemoglobin [mmol/l]	7.9	7.8	1.3
hematocrit	0.39	0.39	0.0
platelets [Gpt/l]	244.5	244.0	0.2
erythrocytes [Tpt/l]	4.20	4.25	- 1.2
leukocytes [Gpt/l]	5.87	5.75	2.0
thromboplastin time [%]	108.0	109.5	- 1.4
aPTT [s]	27.0	27.0	0.0

Tab. 1: Comparison of medians and mean relative difference depending on transport type.

CONCLUSION: Using a single sample PTS noticeably decreases transport time of samples. Acceleration forces acting on samples during transport do not impact the analytical results in a clinical relevant way. Relative differences between results are within the magnitude of the imprecision of the utilized assays. The overall workflow is improved considerably by decreasing hands on time on the ward and in the laboratory without impacting sample quality.

LITERATURE:

[1] Streichert T, Otto B, Schnabel C, Nordholt G, Haddad M, Maric M et al. Determination of Hemolysis Thresholds by the Use of Data Loggers in Pneumatic Tube Systems. Clinical Chemistry 2011; 57(10):1390–7