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Identifying and reducing the cause of haemolysis in coagulation blood samples due to transport in a Pneumatic Tube System

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Introduction

Pre-analytical errors represent 70-90% of laboratory errors. Of these **40-80% are due to in vitro haemolysis**, which may occur during sample **transport**.

In-vitro haemolysis poses a particular problem for haemostasis testing, where **samples are rejected because of known interference** on both mechanical and optical coagulation detection systems.

Pneumatic tube systems (PTS) can induce in-vitro haemolysis from acceleration as specimens are transported from inpatient wards and local outpatient departments (ODP) to the lab for testing.

Aims:

1) Assess whether the PTS contributes to in-vitro haemolysis in coagulation samples, and 2) determine whether packaging carriers could reduce forces experienced by blood samples sent via PTS.

Methods

One each of 4 blood samples (Vacutainer plus, Becton Dickinson) from healthy volunteers (n=30) were paired with VitalVial data loggers and:

1) transported from a distant location to the laboratory via PTS in a transport carrier packaged with bubble wrap
2) same journey in an unpackaged carrier
3) hand-delivered (control)
4) transported from a nearby station via PTS without packaging.

All samples were analysed for haemolysis on a CS5100, and for concentration of plasma haemoglobin. VitalVial data loggers measured the cumulative number of shocks above 2 g as an area under the curve (Streichert et al Clin Chem 2011:57;1390) during transport across the different PTS lines, packaging conditions, and manual transport.

Results

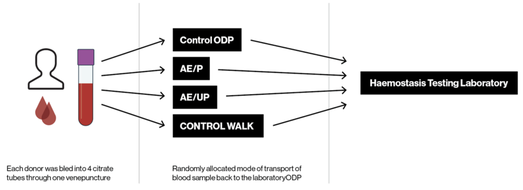
3 of 30 samples transported unpackaged from the distant location were flagged for haemolysis by analyser (10%).

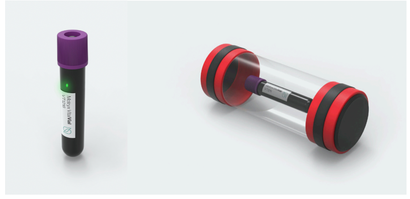
No other samples were flagged, confirming that **haemolysis had occurred in vitro,** and that packaging prevented haemolysis caused by long distance PTS transport.

The **cumulative vibration experienced by samples** in the PTS was highest on the long journey without packaging ($p<0.05$).

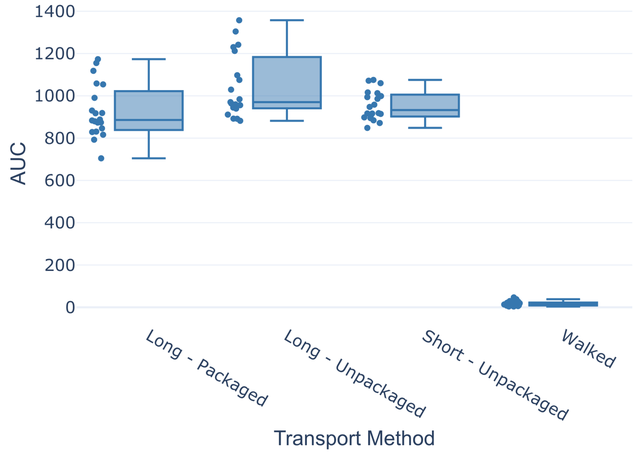
Packaging significantly reduced total vibration in the carrier ($p<0.05$).

Transport	n	Samples rejected for haemolysis	Data logger runs (n)	Cumulative shocks (AUC)	CV (%)
Hand delivered	30	0	19	18.2	93%
Short journey, Unpackaged	30	0	20	954	7%
Long journey, Packaged	30	0	20	926	14%
Long journey, Unpacked	30	3	19	1044	14%





The experimental protocol (left) and datalogger (Motryx VitalVial, VT0; right) used to measure the acceleration that specimens experienced in the pneumatic tube system. The data logger was placed inside the PTS canister as if it were a patient specimen.



Boxplots of the AUC, a cumulative 3-axis vibration parameter, across the four different transport methods, as measured with the Motryx VitalVial.

Conclusion

Packaging carriers significantly reduces vibration experienced within carriers in PTS and **reduced in vitro haemolysis** as detected by CS5100 analyser.

Data loggers were useful to **quantify the extent of vibration** and assess options to reduce it during transport via PTS with **associated improvements in diagnostic quality.**

Each laboratory should evaluate their own PTS for the induction of haemolysis in haemostasis samples.