Investigating the quality of blood products from Canadian blood donors with diabetes

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Canadian Blood Services — Blood, Plasma, Stem Cells, Organs & Tissues
UBC
Bourses d'études supérieures du Canada Vanier Canada Graduate Scholarships
CBR — The Centre for Blood Research

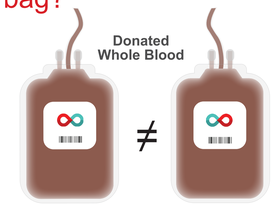
Background

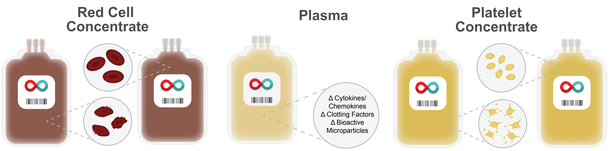
Toward a better understanding of blood product variability and "what's in the bag?"

Since blood products come from human donors, there is inherent variability in their characteristics

Donated whole blood is separated into 3 blood products that are supplied to hospitals for transfusion

Certain characteristics are preferable for certain transfusion contexts





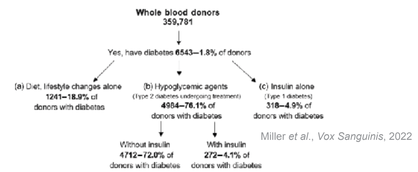
High deformability and low hemolysis is preferred for chronic transfusion contexts

Limiting exposure of very young or critically ill patients to excessive cytokines improves outcomes

High responsiveness and ability to form a strong clot is preferred for acute transfusion contexts

Most invdividuals with diabetes can now donate blood through Canadian Blood Services (CBS)

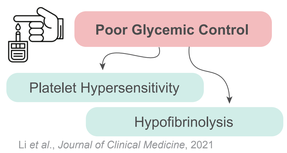
In March 2021, the blanket exclusion criteria for individuals taking insulin was removed. In the first year after this policy change:



Miller *et al.*, *Vox Sanguinis*, 2022

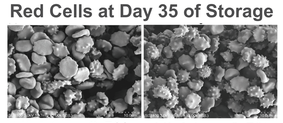
Poor glycemic control may impact characteristics of blood products

Glycemic control is not routinely screened in CBS donors



Li *et al.*, *Journal of Clinical Medicine*, 2021

Red Cells at Day 35 of Storage



HbA1c < 6.5% HbA1c ≥ 6.5%

Adapted from Li *et al.*, *Transfusion*, 2022

Understanding differences in blood products and how they relate to donor characteristics could lead to optimized blood product inventory management

Aims

1. Screen glycemic control in EDTA whole blood from CBS donors with and without diabetes
2. Characterize blood products (red cell concentrate, platelet concentrate, and plasma) from donors with diabetes and age/sex-matched controls

1 Glycemic Control Screen

Approach

ePROGESA — CBS Donor Database

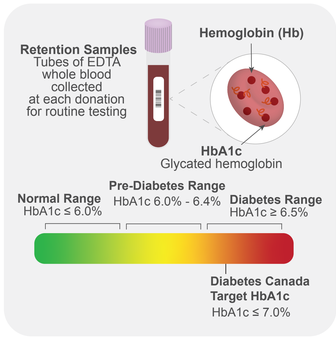
Date: **Mar 2021 - Mar 2022**

Data: **Age, Sex, Medications, Diabetes (Y/N)**

Unused CBS donor retention samples shunted to UBC Centre for Blood Research at next donation for analysis by 6 days post-collection

x100 donors without diabetes | x100 donors with T1D | x100 donors with T2D

HbA1c Measurement



Sub-optimal glycemic control in >50% of CBS donors with diabetes, in line with general Canadian population

Table 1. ***Donor demographics of N=200 specimens analyzed to date.*** Target is N=300.

	No Diabetes	T1D	T2D
N to date	43	71	86
Age, mean ± SD	57.8 ± 10.0	40.2 ± 14.8	57.2 ± 11.6
Females, N (%)	20 (46.5)	45 (63.4)	30 (34.9)
HbA1c, mean ± SD	5.50 ± 0.30	7.22 ± 0.90	7.26 ± 1.28

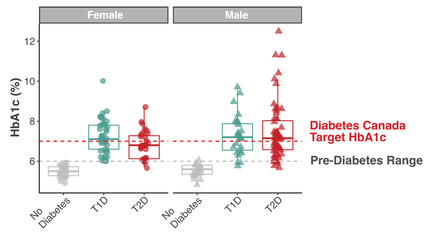


Figure 1. ***HbA1c screen in 200 donors across Canada.*** HbA1c measured in frozen whole blood with Roche immunoassay.

2 Blood Product Characterization

Approach

Vancouver donors recruited to donate a full unit of blood for research

Sampled across eligible age range (21-90)

T1D N = 16 | T2D N = 16 | Aging/Control Cohort N = 70

Co-Variates Collected: Age, Sex, Ethnicity, Height/Weight, Diabetes Duration, Current Medications, Drinking/Smoking Habits

HbA1c, Lipid Panel, CBC

EDTA Whole Blood → CPD Whole Blood

7 days storage → Platelet Concentrate

42 days storage → Red Cell Concentrate

Resulting blood products characterized across storage periods

Blood Gas Analysis, CBC, Rotational Thromboelastometry (Clot Formation - Intrinsic and Extrinsic Pathways), Activation, Response to ADP, PS Exposure (Apoptosis), Banking for Proteomics/Metabolomics

Blood Gas Analysis, CBC, Storage Hemolysis, Oxidative Hemolysis, Ektacytometry (Response to Shear/Osmotic Stress), Banking for Proteomics/Metabolomics

Sample of whole blood donors with diabetes to date has excellent glycemic control

Table 2. ***Demographics and whole blood measures of N=49 donors analyzed to date.*** Data shown is mean ± SD unless otherwise indicated. Target is N=102.

	All Controls	T1D	T1D Matched Controls	T2D	T2D Matched Controls
N to date	40	2	2	7	7
Age, mean (range)	58.1 (23.82)	33 (25,41)	38 (27,49)	59.9 (44,70)	59.4 (40,71)
Females, N (%)	22 (55)	2 (100)	2 (100)	5 (71.4)	5 (71.4)
BMI (kg/m²)	25.3 ± 7.0	34.5 ± 6.3	24.7 ± 2.7	28.3 ± 4.0	25.1 ± 4.5
HbA1c (%)	5.29 ± 0.28	**6.30 ± 0.14**	5.15 ± 0.07	**6.12 ± 0.63**	5.41 ± 0.30
EDTA PLT (x10⁹/L)	235.4 ± 49.9	278.0 ± 12.7	244.0 ± 2.8	252.3 ± 58.4	240.0 ± 45.3
EDTA RBC (x10¹²/L)	4.64 ± 0.40	4.35 ± 0.14	4.38 ± 0.25	4.71 ± 0.21	4.74 ± 0.56
Total Cholesterol (mmol/L)	4.77 ± 0.87	4.22 ± 0.08	4.80 ± 1.30	4.48 ± 1.12	4.84 ± 1.13
HDL Cholesterol (mmol/L)	1.55 ± 0.46	1.35 ± 0.33	1.90 ± 0.07	1.41 ± 0.28	1.70 ± 0.58
Triglycerides (mmol/L)	1.69 ± 0.90	1.05 ± 0.90	0.96 ± 0.11	1.66 ± 0.63	1.41 ± 0.61

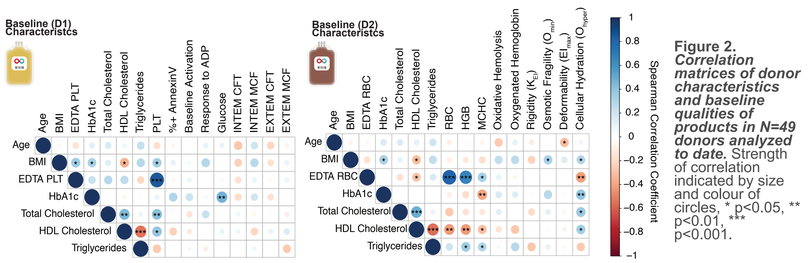


Figure 2. ***Correlation matrices of donor characteristics and baseline qualities of products in N=49 donors analyzed to date.*** Strength of correlation indicated by size and colour of circles, * p<0.05, ** p<0.01, *** p<0.001.

2 Preliminary Quality Comparisons

Initial data does not suggest clinically relevant differences in storage of blood products from donors with diabetes

Figure 3. ***Clinical measures of storage performance used at CBS for platelet concentrate and red cell concentrate.*** Thick grey line represents LOESS regression of all controls, with shaded area as 95% CI.

Functional variability in blood products is not driven by diabetes alone

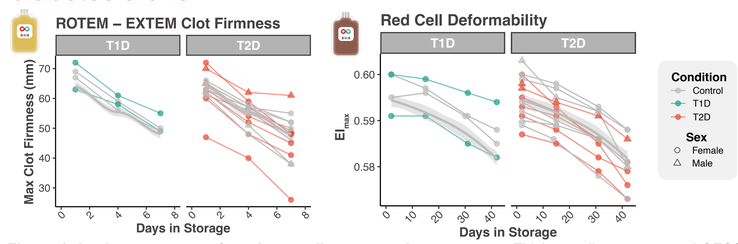


Figure 4. ***In vitro measures of product quality assessed over storage.*** Thick grey line represents LOESS regression of all controls, with shaded area as 95% CI.

Conclusions & Next Steps

- Suboptimal glycemic control in the majority of CBS donors could indicate considerable differences in resulting blood products
- Initial data does not suggest clinically relevant differences in blood products from donors with diabetes.
- Conclusions are currently limited by sample size and great glycemic control of donors in Aim 2. Data collection for both aims is ongoing with plans for -omics analyses.