

Stress-induced hemolysis in red blood cell subpopulations of different donors during hypothermic storage



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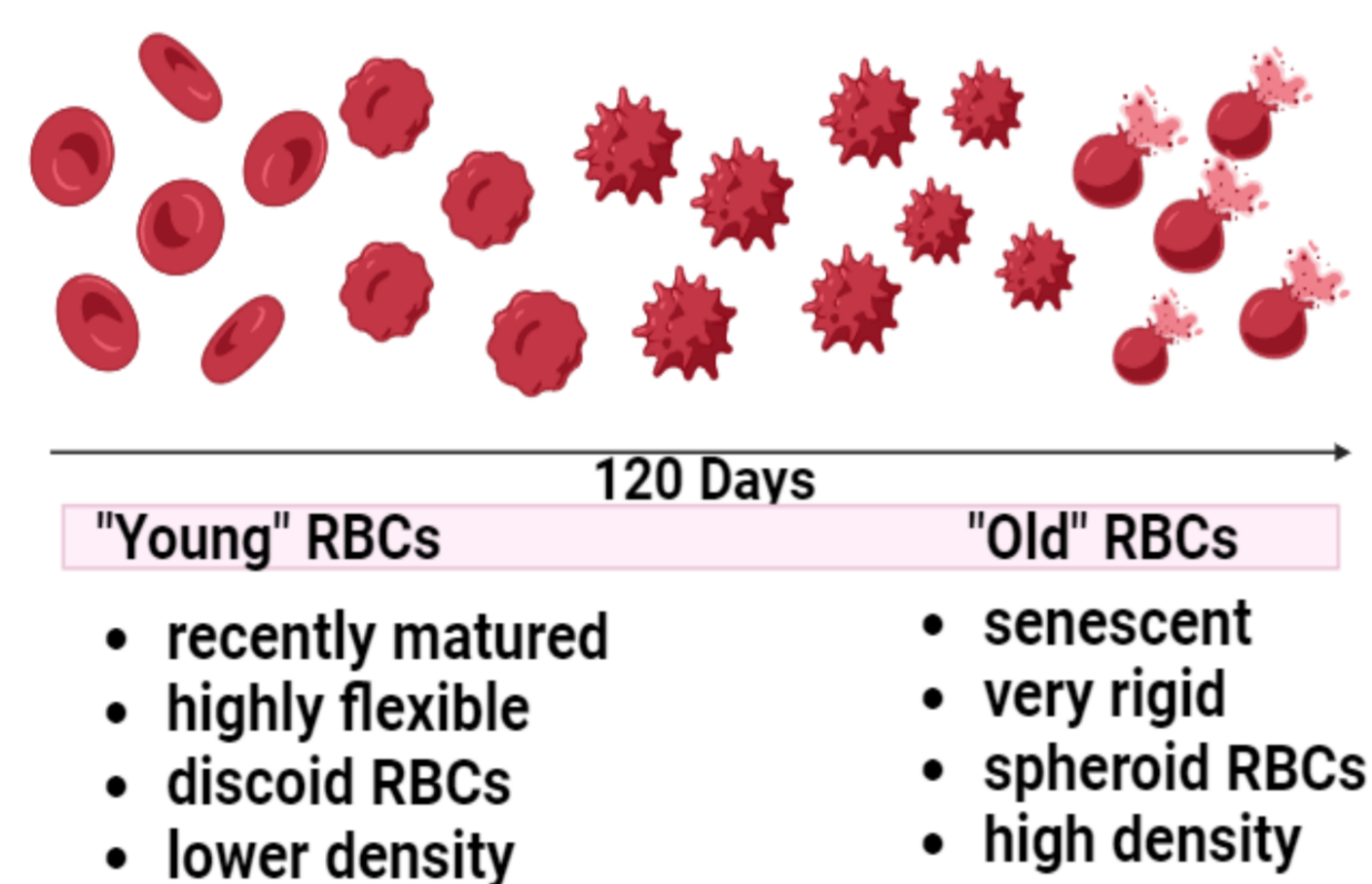


INTRODUCTION

- Red Cell Concentrates (RCCs) contain cells at different stages of their life cycle.
- The aging of red blood cells (RBCs) leads to decreased mean corpuscular volume (MCV) and increased mean corpuscular hemoglobin concentration (MCHC), resulting in denser old RBCs (O-RBCs).
- Donor factors, such as age and donation frequency, influence the quality of red cell concentrates (RCCs) during hypothermic storage.
- Teenage male donors' RCCs contain elevated levels of biologically old RBCs with higher oxidative stress.^{1,2}

Objective:

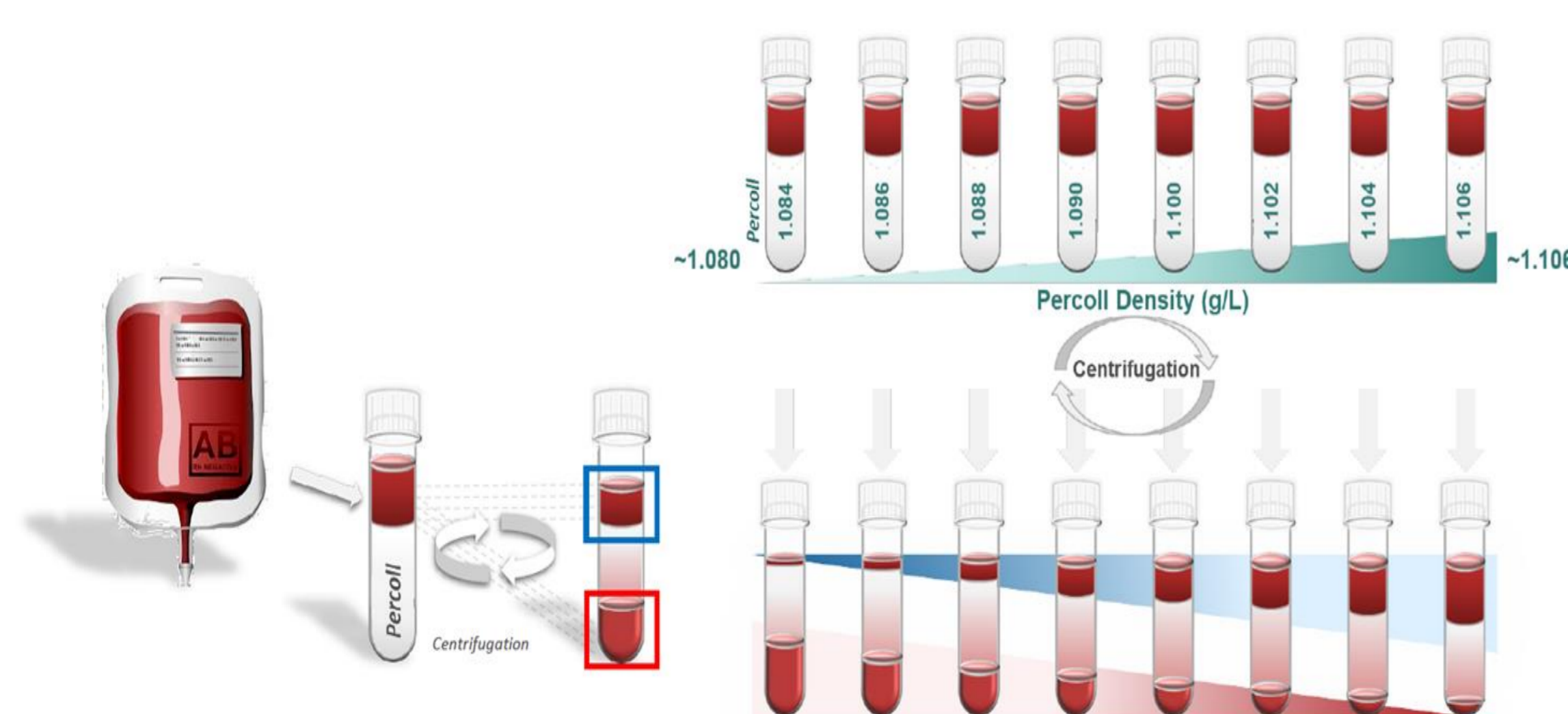
Evaluation of stress-induced hemolysis of the subpopulation of “young” and “old” RBCs during hypothermic storage as a function of the blood donor age and frequency of blood donation.



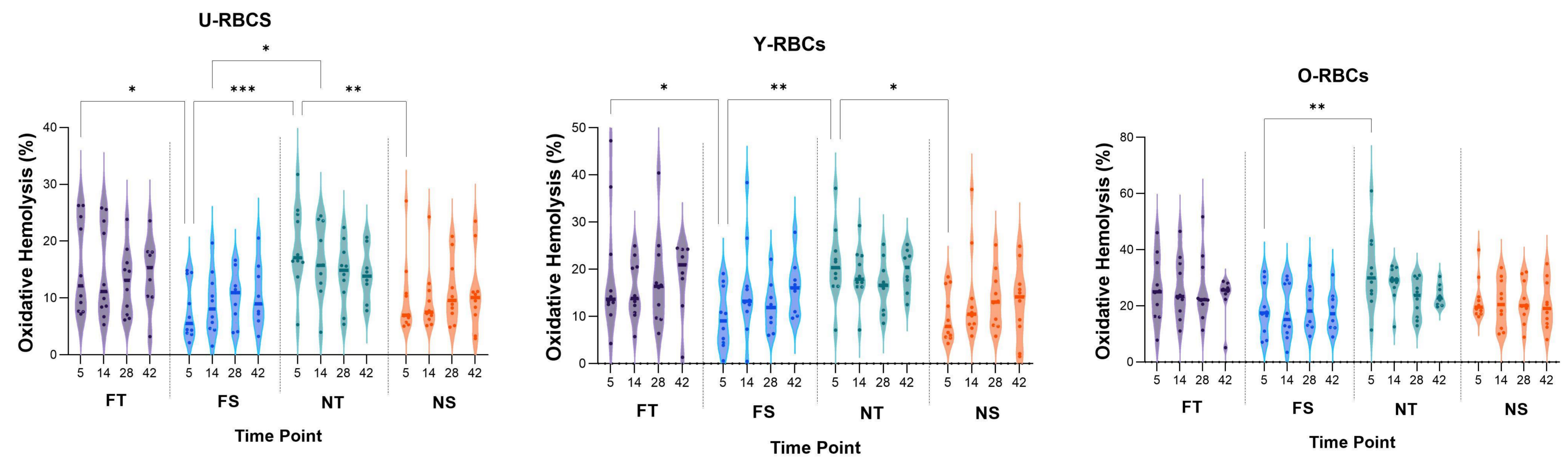
METHODS

- RCCs Samples from different donors were percoll-density separated into portions of less dense / recently matured (young; Y-RBCs) and dense / senescent (old; O-RBCs).
- Changes in MCV, MCHC, HCT and oxidative hemolysis were assessed on days 5,14, 28, and 42 of storage using established quality tests.

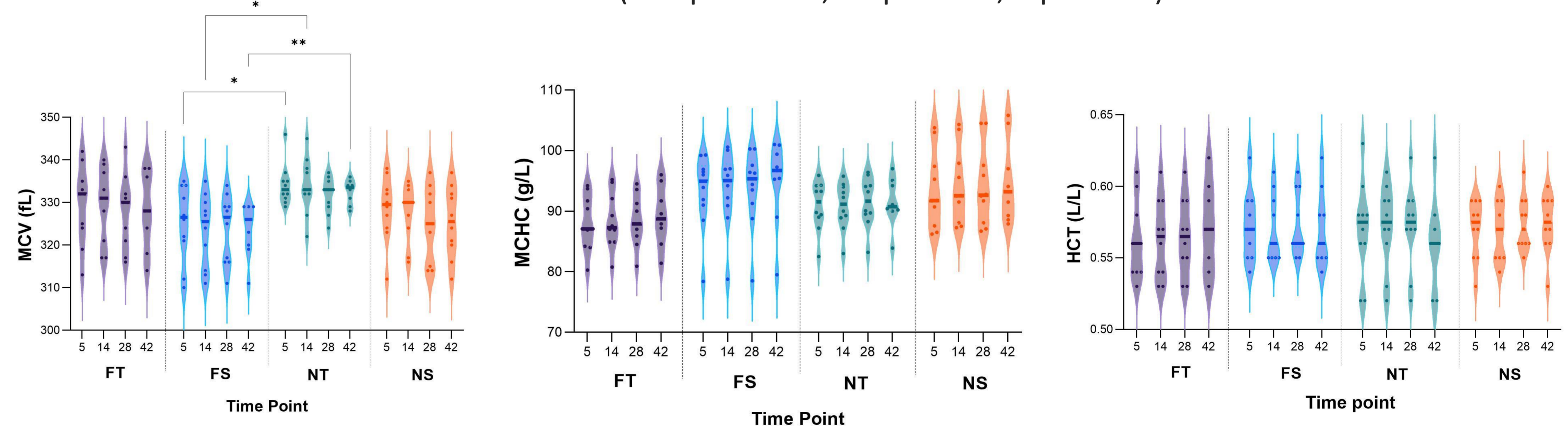
	Teen 17-19 yo	Senior > 75 yo
Frequent (> 3 donation per year)	n=5	n=5
Non-frequent (1 donation per year)	n=5	n=5



RESULTS



FT: Frequent Teen
FS: Frequent Senior
NT: Non-frequent Teen
NS: Non-frequent Senior



- **O-RBCs** from stored RCCs exhibited increased oxidative hemolysis with RCCs from **teenage frequent donors** exhibiting the highest susceptibility to hemolysis on day 42 of storage ($p=0.007$). **Y-RBCs** from **frequent senior donors** had the lowest oxidative hemolysis compared to other donor groups on day 5 of storage ($p=0.009$). (***) $p < 0.001$, ** $p < 0.01$, * $p < 0.05$).

- MCV tends to decrease slightly over storage. The **FT and FS groups** maintain relatively higher MCV levels throughout the storage period, with FT showing more consistent results compared to FS. The NS group displays a similar trend to NT, but with slightly higher variability across the time points. ($p=0.007$)
- MCHC levels increase slightly as storage time progresses across all donor groups. The **NT group** shows more variability in MCHC, particularly at earlier time points, while NS, FT, and FS groups have more consistent patterns. The highest MCHC is related to FS group.
- **FT and FS groups** showed similar trends, with HCT levels slightly increasing with storage time, peaking around day 42. NT and NS display more variation in HCT values compared to the other groups.

CONCLUSIONS

- Frequent senior donors demonstrated better resistance to oxidative damage, while teenage frequent donors showed higher susceptibility to hemolysis, especially in long-term storage.
- These insights could guide donor selection and optimize storage protocols, potentially improving the efficacy of RBC transfusions.

Implication:

This study emphasizes that donor factors should continue to be considered for their potential impacts on transfusion outcomes for providing an improved products.

ACKNOWLEDGEMENTS

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REFERENCES

1. Mykhailova O, et al. Red cell concentrates from teen male donors contain poor-quality biologically older cells. *Vox Sang.* 2024; 119(5): 417-427.
2. Mykhailova O, et al. Estimated median density identifies donor age and sex differences in red blood cell biological age. *Transfusion.* 2024 ;64(4): 705-715.