TERUMO BLOOD AND CELL TECHNOLOGIES

Unlocking Potential

Prospective Assessment of Operational Efficiency and Quality Parameters of Blood Units Processed by Manual Versus Fully Automated Whole Blood Systems in a Regional Argentine Blood Bank

Nil Comasòlivas, MSc, MD[1,2]; Paula Gentile, BSc[1]; Victoria Paez, MD[3]; Laura Rimorini, BSc[3]

[1]Terumo Blood and Cell Technologies, Lakewood, Colorado, USA. [2]Universitat de Barcelona, Barcelona, Spain. [3]Centro Regional de Hemoterapia de La Plata, La Plata, Argentina.

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Introduction

Recently, blood banks have increasingly focused their efforts on the systematic evaluation of multiple parameters related to processed blood products, operational procedures, and technological systems, aiming to maximize standardization, enhance production efficiency, and ensure high quality standards throughout the entire process.

There are three types of blood processing systems: Manual, which uses traditional techniques and requires high human intervention; semi-automated, which improves component separation by replacing manual presses with automated separators; and fully automated, which allows complete processing to obtain the three final blood components using a single device.[1][2][3][4]

Objectives

The objective of this study is to compare manual systems (MS) and fully automated systems (FAS) for whole blood processing by analyzing operational and quality parameters of the processed blood components in a regional Argentine blood bank.

Materials and Methods

From April to July 2024, value stream mapping was carried out in the blood bank processing rooms to evaluate manual steps and average time to process whole blood (WB) into the three final blood components: red blood cell concentrates (RBCCs), interim platelet units (IPUs), and plasma concentrates (PCs), using both MS and FAS.

For the MS, a prospective analysis of 14 quality parameters was performed on 100 WB and their three final components: 100 RBC, 100 IPU, 100 PC.
The equipment used included a centrifuge (Presvac DP-2065 R Plus), a manual press (Presvac BP-600), a scale (Kretz Single Eco 2), a tube sealer (SureSeal), and blood bag sets (Terumo Blood and Cell Technologies PB-3AO456Z0Y).

For the FAS, a prospective analysis of 14 quality parameters was performed on 110 WB and their three final components: 110 RBCCs, 110 IPUs, 110 PCs.

The device used was the Reveos™ Automated Blood Processing System with Reveos NLR blood bag sets (device and sets from Terumo Blood and Cell Technologies).

The hematology analyzer used in both methods was Counter 19 (Wiener lab).

Table 1 presents the parameters and results obtained.

Conclusions

The introduction of FAS in a regional Argentine blood bank has improved the operational performance in whole blood processing by reducing the number of manual steps that operators are required to perform, as well as the total processing time.
In addition to operational optimization, FAS produced RBCCs that had, on average, a reduction in volume, leukocytes and platelet counts, together with increased hemoglobin concentration and hematocrit levels; IPUs that had, on average, a reduction in volume, red blood cell contamination and platelet aggregates, and an increased leukocyte and platelet count; and PCs that had, on average, higher volume.

Based on the results of this study, the authors consider FAS the preferred option for whole blood processing in Centro Regional de Hemoterapia de La Plata.

Results

MS required the operator to perform a total of 80 manual steps, while FAS required a total of 46. The average total time to process 12 WB using MS was 2 hours and 54 minutes, whereas using FAS was 2 hours and 2 minutes.

For WB processed with MS versus FAS, no statistically significant differences were found (*P* value > 0.05) in hemoglobin (MS: 14.82 ± 3.51g/dL; FAS: 15.02 ± 1.29g/dL); hematocrit (MS: 42.37 ± 3.26%; FAS: 42.47 ± 3.35%); leukocytes count (MS: 7.04E+09 ± 1.70E+09/L; FAS: 7.03E+09 ± 1.60E+09/L); and platelet count (MS: 2.56E+11 ± 5.62E+10/L; FAS: 2.54E+11 ± 4.94E+10/L). There was a statistically significant difference (*P* value = 0.036) in average volume (MS: 458.67 ± 7.27mL; FAS: 456.87 ± 5.00mL).

For RBC processed with MS versus FAS, statistically significant differences (*P* value < 0.001) were found in average volume (MS: 369.42 ± 24.55mL; FAS: 279.07 ± 19.94mL); hemoglobin (MS: 17.25 ± 1.69g/dL; FAS: 19.42 ± 1.08g/dL); hematocrit (MS: 51.43 ± 4.56%; FAS: 55.72 ± 2.53%); leukocytes count (MS: 8.03E+09 ± 2.46E+09/L; FAS: 2.33E+09 ± 1.23E+09/L); and platelet count (MS: 1.17E+11 ± 4.97E+10/L; FAS: 4.04E+10 ± 2.48E+10/L).

For IPU processed with MS versus FAS, statistically significant differences (*P* value < 0.001) were found in average volume (MS: 63.07 ± 5.07mL; FAS: 60.41 ± 6.06mL) and leukocytes count (MS: 3.82E+07 ± 6.31E+07/L; FAS: 2.45E+08 ± 2.69E+08/L). No significant differences (*P* value = 0.27) were found in platelet count per unit (MS: 6.95E+10 ± 2.56E+10/unit; FAS: 7.37E+10 ± 2.69E+10/unit). Visual inspection of IPU showed red blood cell contamination (MS: 47%; FAS: 1%) and platelet aggregates (MS: 16%; FAS: 14%).

For PC processed with MS versus FAS, statistically significant differences (*P* value < 0.001) were found in average volume (MS: 195.88 ± 24.52mL; FAS: 216.40 ± 22.54mL).

Table 1. Inclusion of the parameters analyzed from WBB, RBC, IPU and PC, processed using the MS vs. FAS. For each parameter, average and standard deviation were calculated. Statistical significance is considered when p-value<0.05.

		Manual System (MS)		Fully Automated System (FAS)		
Products	**Parameters**	**Average**	**Standard Deviation**	**Average**	**Standard Deviation**	***P* value**
Whole Blood Bag (WBB)						
	Volume (mL)	**458.67**	7.27	**456.87**	5.00	**0.0362**
	Hemoglobin (g/dL)	**14.82**	3.51	**15.02**	1.29	0.5746
	Hematocrit (%)	**42.37**	3.26	**42.47**	3.35	0.8343
	Leukocytes (count/L)	**7.04E+09**	1.70E+09	**7.03E+09**	1.60E+09	0.9935
	Platelets (count/L)	**2.56E+11**	5.62E+10	**2.54E+11**	4.94E+10	0.7887
Red Blood Cell Concentrate (RBCC)						
	Volume (mL)	**369.42**	24.55	**279.07**	19.94	**0.0000**
	Hemoglobin (g/dL)	**17.25**	1.69	**19.42**	1.08	**0.0000**
	Hematocrit (%)	**51.43**	4.56	**55.72**	2.53	**0.0000**
	Leukocytes (count/L)	**8.03E+09**	2.46E+09	**2.33E+09**	1.23E+09	**0.0000**
	Platelets (count/L)	**1.17E+11**	4.97E+10	**4.04E+10**	2.48E+10	**0.0000**
Interim Platelet Unit (IPU)						
	Volume (mL)	**63.07**	5.07	**60.41**	4.42	**0.0001**
	Leukocytes (count/L)	**3.82E+07**	6.31E+07	**2.45E+08**	2.69E+08	**0.0000**
	Platelets (count/Unit)	**6.95E+10**	2.56E+10	**7.37E+10**	2.69E+10	0.2754
Plasma Concentrate (PC)						
	Volume (mL)	**195.88**	24.52	**216.40**	22.54	**0.0000**

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Contact email: Health.Economics@TerumoBCT.com