Original Research Article

Assessment of Blood and Component Preparation Programming under applied programming

ABSTRACT

Background and objective

Component preparation is the backbone of blood centre services.Every blood centre follows standard operative techniques, for component preparation and accepts units with match quality uses for patient services.For component preparation units specific equipment named a refrigerated centrifuge machine is used, which works on the principle of centrifugal force and centripetal force.The best programming defined the above qualitystandard for every separated unit.The objective of the above study is the evaluation of programming of component preparation over centripetal, centrifugalforces acceleration, and deceleration with timeintervals. Selection forthe bestprogram ,whichwould matches the standard.

Material and Methods

The study was observed over two different highly specialized equipment refrigerated cytocentrifuge machines known as (Rota Silenta and Thremofisher centrifuge), they are programmed for component preparation. Various programming followed by their Acceleration, Deceleration, Mid-interval Time,RPM, RCF, and Gravitational force,(G) were studied. Prepared products (PRBC,FFP,PC and WBC),their quality frequency was checked with a Fully Automated Hematology Analyzer evaluated.

Result

HERAEUS CRYOFUGE 16 Centrifuge results outcome was better compared to **ROTA SILENTA630 RS.** The best programming of **Heraeus croyofuge** ACCELERATION (8)mins,DACCELARTION(8)mins and mid-interval (3)mins RPM,2350 and 3450 of 30 cm radius G Computed RCF was 2096 and 4018 noted.The above programming gives the best yield of platelets-287ug/dl, least contamination of FFP of RBC(.01) and platelets(24)ug/dl, prepared PRBC was HCT(69%),RBC was(9.6)ug/dl,and platelets contamination was(186)ug/dl. Among **ROTA SILENTA** best programmed was Acceleration (8), MID-Interval (3) and Deceleration (4)minsat RPM(2190,3250) with radius(29.5)cm along G computed RCF(1342,3018)noted respectively, which gave best product after processing.

Conclusion

Section of best programming meets the quality standard and produces the best efficacy in terms of platelets preparation (yield), (hematocrit)-and PRBC preparation. Prepared FFP was less

contaminated with RBC and matched with the defined log reduction of WBC. The selection of programming can enhance the quality criteria and meet the above standard product.

Key word-PRBC(PACKED CELL RBC),WBC-WHITE BLOOD CELLS,FFP-FRESH FROZEN PLASMA,RCF-RPTATION CENTAL FORCE,RPM-ROTATIONAL PER MINUTES

1. Introduction

Component preparation plays a vital role in blood center services, with adherence to standardized procedures. The viability of the whole blood has been improved since it was collected in CPD solution and proceeds with standard component preparation[1,6]. For component preparation units specific equipment named a refrigerated centrifuge machine is used, which works on the principle of centrifugal force and centripetal force. The best programming defined the above quality standard for every separated unit. The objective of the above study is the evaluation of programming of component preparation over centripetal, centrifugal forces acceleration, and deceleration with time intervals. Selection of the best program, which will match the standard

2. Aim

Selection of most suitable programs for component preparation which could raises quality standard of prepared component.

To evaluate the programming of component preparation concerning acceleration, deceleration, and time intervals comparison to basic programs

3. Objective

Modification of present programming and observe the changes of prepared component (**PRBC, FFP, PLT)** over the applied programs.

4. Research question- can we improve present programming and find other alternative programs which is more suitable for components products?

Intervention-Modification of programming over blood component preparation equipment

Comparison group-among two placed equipment's {Thermo fisher and Agile} with their derived products standards and compare with present programming products

5. Time period-expected duration of 3 months

6. Study design-observationalretrospective study

7. Population- Eastern India region, among healthy blood donors.

8.Outcome measures-PRBC[highest standards of product presence can be evaluated by HB,HCT,RBC,PLT] ,PLT-[Contamination of RBC,WBC,HCT and plt count] ,FFP- Contamination of RBC,WBC,HCT

9. Sample evaluation-20 each as pilot samples for both of equipment.

10. Methodology

Present program for Thermofishercryocentifuge

RPM (2350/3450), RCF(1048x2/2054x2), Acceleration (9),Deceleration(10) and Mid interval(8).

Present program for Agile centrifuge

RPM(2190/3250) ,RCF(671x2/1509x2),Acceleration (7),Deceleration(9) and Mid interval(9).

11. Materials and Methods

Two specialized refrigerated cytocentrifuge machines, Rota Silenta and Thremofisher centrifuge, were observed and analyzed for component preparation programming. Parameters such as acceleration, deceleration, mid-interval time, RPM, relative centrifugal force (RCF), and gravitational force (G) were studied. The quality and frequency of prepared blood products (PRBC, FFP, PC, and WBC) were assessed using a Fully Automated Hematology Analyzer[2].

Table 1.Modified/Applied Croyocentrifuge(programs)

PROGRAMME	**RPM-Hard spin/Soft spin**	**RCF**	**DIAMETER**	**TIME**	**MID-TIME**	**ACCELERATION**	**DEACCELARATION**
Thermofisher	3450/2350	2054X2/10480X2	30/29				
P1	do	do	do	21	9	8	4
P2	do	do	do	19	8	8	3
P3	do	do	do	20	9	8	3
P4	do	do	do	24	10	10	4
P5				25	10	10	5
Rota silenta	3250/2190	1509X2/671X2	29.5/28.5				
PI	do	do	do	23	12	8	3
P2	do	do	do	20	11	7	2
P3	do	do	do	21	12	7	2
P5	do	do	do	25	13	8	4
P6	do	do	do	27	13	9	5

The module of the different programs estimated over RCF, RPM, MID-INTERVAL, ACCELERATION and ACCELERATION.

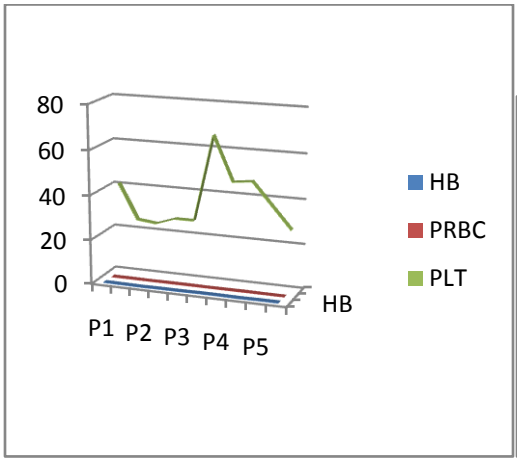
12. Results

The HERAEUS Thermofishercryocentifuge 16 Centrifuge outperformed the ROTA SILENTA 630 RS. The optimal programming for the HERAEUS CRYOFUGE involved acceleration (8 minutes), deceleration (8 minutes), mid-interval (3 minutes), and RPM (2350 and 3450), with calculated RCF values of 2096 and 4018. This programming resulted in the highest platelet yield (287ug/dl), minimal FFP contamination by RBC and platelets (0.01 and 24ug/dl, respectively), PRBC with a hematocrit of 69%, RBC concentration of 9.6ug/dl, and platelet contamination of 186ug/dl.

Comparison to applied programming (P2) to present programs, present program observed inferior platelets yield (189ug/dl), FFP-Contamination by RBC and platelets observed (.02 and 26Ug/dl) respectively).

For the ROTA SILENTA, the best programming included acceleration (8 minutes), mid-interval (3 minutes), deceleration (4 minutes), RPM (2190 and 3250), with a radius of 29.5cm and computed RCF values of (1342 and 3018), respectively, resulting in the highest-quality products.

Comparison to applied programming (P4) of ROTA present programs also observed platelets yield (198ug/dl)FFP Contamination by RBC and platelets (.02 and 24Ug/dl) respectively.



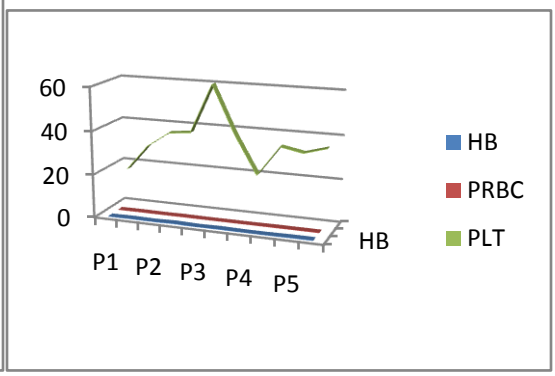


Fig-1FFP (Thermofisher)

Fig-2 FFP(Rota)

Fig1, (Thermofisher)

[above graphical presentation of the outcome of programs of cryocentifuge which represent HB and PRBC lies over the lower side while contamination of prepared FFP products highest noted with platelets.P2 was associated with lowest contamination of HB and PRBC (.1) and (.01)

respectively. platelets was 24u/dl in P2.The highest contamination of HB, PRBC and platelets was in P3 (.2),(.01)and (27)respectively.

Fig-2FFP (Rota)

Above graphical presentation of the outcome of programs of cryocentifuge which represent HB and PRBC lies over the lower side while contamination of prepared FFP products highest noted with platelets. P2 was associated with the lowest contamination of HB and PRBC (.04) and (.01) respectively. Platelets were 36u/dl P2 at the lowest in P4 (20)ul/dl. Highest contamination of HB, PRBC and platelets was in P3 (.3)gm/dl,(.1)ul/dl and (60)ul/dl respectively.

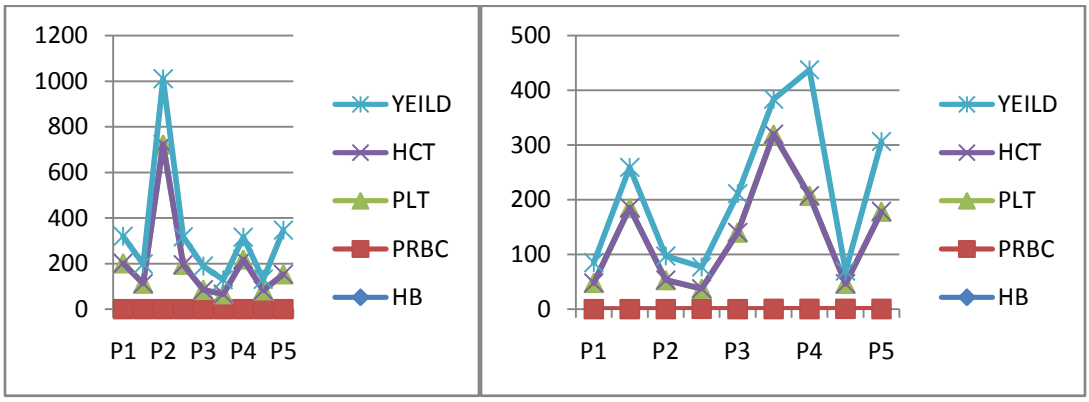


Fig-4PLT (Rota)

FigG-3 PLT (Thermocentrifuge)

Fig 3 (Thermocentifuge)

Above graphical presentation of the outcome of programs of cryocentifuge which represent HB, PLT, HCT, YEILD and PRBC. Here PRBC lies over the lower side while contamination of prepared PLT products is highest noted with PRBC and negligible with wbc (.1)ul/dl. P2 was associated with the lowest contamination of HB and PRBC (.2) and (.02) respectively. Platelets were 722u/dl in P2. Highest contamination of HB, PRBC and HCT was in P1 (.4),(.04)and (.3)respectively. The highest yield of PLT was achieved in P2 (288) and the lowest was P4(48).

Fig-4PLT (Rota)

Above graphical presentation of the outcome of programs of cryocentifuge which represent HB, PLT, HCT, YEILD and PRBC. Here PRBC lies over the lower side while contamination of prepared PLT products is highest noted with PRBC and negligible with WBC(.1)ul/dl. P1 was associated with the lowest contamination of HB and PRBC (.2)ul/dl and (.02)ul/dl respectively. Platelets were 319u/dl in P3. Highest contamination of HB, PRBC and HCT was in P4 (.4),(.04)and (.3)respectively. The highest yield of PLT was achieved in P4 (230)and the lowest was P3(74).

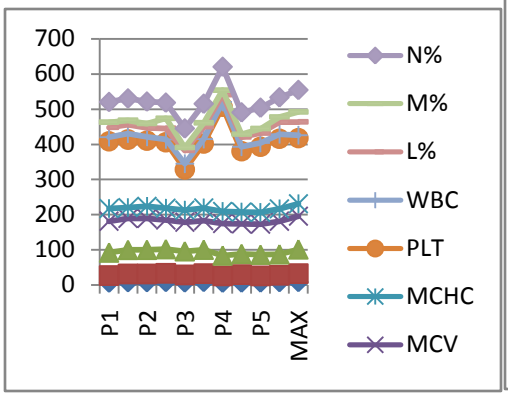


Fig-5.PRBC (Thermocentrifuge)

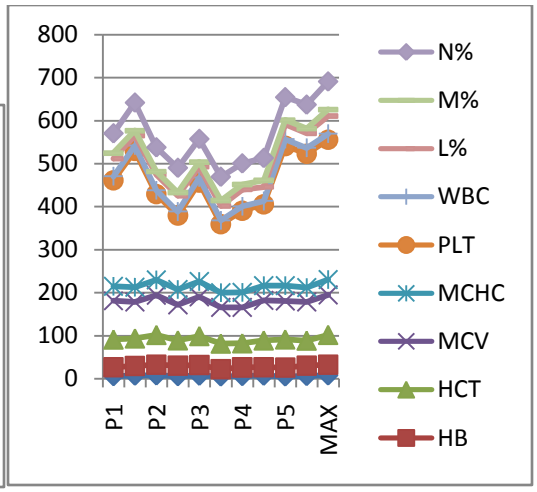


Fig-6.PRBC Rota

Fig 5 thermo[above graphical presentation of the outcome of programs of cryocentifuge which represent HB, PLT, HCT, MCV, MCHC, WBC, L%, M%, N% and RBC. Here concentrated PRBC lies over the lower side(8.4)ul/dl while contamination of prepared PRBC products Lowest noted with PLT, HCT and WBC (186)ul/dl, (68.8%)and (8.25)ul/dl in P2. Maximum MCV and MCH were in P5 and P3 respectively.

FIG 6. PRBC Rota

above graphical presentation of the outcome of programs of cryocentifuge which represent HB, PLT, HCT, MCV, MCHC, WBC, L%, M%, N% and RBC. Here concentrated PRBC lies over the lower side(8.4)ul/dl while contamination of prepared PRBC products Lowest noted with PLT, HCT and WBC (153)ul/dl, (68.8%)and (69.7)ul/dl in P4. Maximum MCV and MCH were in P4 and P5 respectively.

13.Statistical analysis

Conducting a chi-square test, multivariate programming for component preparation was assessed**. P2** yielded the highest platelets (PLT) at 288, while P4 showed the lowest at 48 for the cytocentrifuge. In the case of Rota Silent, **P4 h**ad the highest PLT yield at 230, with P3 having the lowest at 74. Overall**, P2** demonstrated the most significant product effect across all variables, with statistical significance at an estimated p-value of <0.05. In terms of PRBC (Rota Silent**), P4** emerged as the best-programmed choice.

Table 2.Result of data statistics

programs	PLT yield/count	FFP contamination	Chi-square	P value at<.05
P2 Thermofisher	287	**24**	**.32**	
Present program for Thermofisher	**183**	**26**	**.53**	
P4 Rota	**240**	**24**	**.05**	

Present programs	**198**	**26**	**.81**	
P2 Thermofisher	**287**	**24**	**.37**	
P4 Rota	**240**	**24**	**.53**	

T test statics at confidence of variance (.01) computed as (.04) with digree of freedom (18) estimated p value obtained (.4842) which was not significant at <.05.

14. Advantage and disadvantage of present program

To satisfy quality standard any prepared component must be passes 60 to 75% the quality standard as per advisory guideline of D&CGuideline.[6] Our present prepared component comes as 60%..Rest of prepared component may be discarded or reprograms to meet the standard. Which in terms it may become time consuming, when we have need to reprogramming. Some contaminated product in terms of FFP, which may have to discard due to contamination of RBC. if we need of high yield of platelets we should modify programming of platelets preparation and select the best programs.

In terms of RBC preparation selection of high concentrated PCV -RBC needed which is again correct by modification of present programs. Contamination of WBC in RBC product is reason behind causing non-hemolytic febrile transfusion reaction. This can also modified by selection of best programs which could support less contamination of WBC in any product.

Contamination of RBC in FFP and platelets are not useful in RH negative patient. This has been also modified by selection of best programs of component preparation.

15. Discussion

A centripetal and centrifugal major force which acts on component preparation, above force, leads to the rotation of a specific component and settle down of separated product according to specific gravity. Most lower down attended by PRBC, BUFFY COAT layer Platelet layer followed by plasma[2]. The plasticizer for blood products significantly reduces the storing lesion and quality of the stored product[3]. The above study was conducted over SAGM and non-SAGAM Blood bags with the collection of 350 ml blood bag which was not the leukoreduced blood bags. Determination of leukoreduced product is essential that might be >1 microliter and closure to the above value by NC methods or flowcytometry is gold slandered[4].Wm,Andrew et al, had shown different methods of platelets preparation with holding time of product and residual WBC, above study observed a similar manner and productive results assimilated.

16. Novelty

Identify the optimal program meeting quality standards

Best Counted/yield PLT product could be selected for platelets transfusion requirement.

Least contamination of FFP will be selected to avoid the transfusion reaction.

Decrease in Discard rate due to contamination among FFP could be minimizing.

Selection of different group requirement becomes easy when we have comprised stock or absence.

17. Conclusion

Selecting the optimal programming parameters enhances product quality and meets established standards for platelet preparation, hematocrit, and PRBC preparation. FFP contamination with RBC aligns with the defined log reduction for WBC. The choice of programming can significantly improve product quality and adherence to standards.

18. ETHICAL APPROVAL- ETHICAL APPROVAL HAS BEEN TAKEN-REF.NO-RD/AIIMS/PAT/RAC/29

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