

BLOOD VOLUMES OF PAKISTANI MALE DONORS: IMPLICATIONS FOR BLOOD DONATION

Dr. Nuzhat Salamat

FCPS (Haematology), CTM
(Transfusion Medicine, UK)



Donor selection

- Procedures are adopted for the safety of both the donor and the recipient
 - medical history
 - limited physical examination of the donor, on the day of donation



Significance of body weight

- Donor weight roughly indicate the volume of blood that can be safely collected
- 10-15% of donor's estimated blood volume safe limit
- In absolute quantities this varies:
 - 250 ml in some Asian countries
 - 350-400 ml in Turkey, Greece and Italy,
 - 450 ml in UK
 - 525 maximum in USA



Blood volume estimation

- Prediction of blood volume with weight alone is inaccurate.
- Non-invasive methods and calculations for estimating blood volume:
 - height, weight,
 - body surface area
 - skin fold thickness
- These calculated blood volumes are the best approximates to the invasive measured total blood volume (TBV), (RCV) and (PV).
- These volumes may vary among population groups.
- Appropriate to develop guidelines/ standards for indigenous population based on local data or data pertaining to the differences



Measurement of blood volumes

- The exact RCV and PV can only be measured using standardized methods:
 - ^{51}Cr labeling of red cells
 - $^{99\text{m}}\text{Tc}$ of albumin
 - ^{111}In Indium labeling albumin
- Limitation is invasiveness
- method accuracy of 2-3 %

Radionuclide panel of the International Committee for Standardization in Haematology (ICSH)



mathematical calculations

- Pearson et al, derived equations from direct measurement of RCV and PV from selected published papers
- 99 % of the measured values were within $\pm 25\%$ of the predicted mean normal values

Pearson TC, Guthrie DL, Simpson J, Chinn S, Barosi G, Ferrant A et al. Interpretation of measured red cell mass and plasma volume in adults: Expert panel on Radionuclides of the International Council for standardization in Haematology. Br J Haematol 1995; 89(4):748-756.



- The national guidelines for blood transfusion services of Pakistan

(Public health division of National Institute of Health)

- Same as UK guidelines in the red book
- No reference to any local data
- Objective local data needed so that evidence based guidelines can be made or revised



Aim of study

- To estimate or calculate blood volumes of Pakistani male donors using two different equations in a cross sectional study design.



methodology

- Male blood donors reporting to blood bank of Combined Military Hospital, Multan, for six months
- Height in feet and inches and weight in kilograms was recorded, with standardized scale
- Correlated with the historical weight and height known to the donors themselves.



Variables

- data was entered in SPSS 10.0 and calculations performed
- variables labeled
 - unique donation number
 - age of the donor
 - height in feet and inches
 - height in centimeters
 - weight in kilograms
 - Body surface area (BSA)
 - total blood volume with two equations using BSA
 - the difference of blood volume obtained from two Equations

Equations used for calculation

Equation	BSA (m2) calculation	RCV (ml) calculation	PV (ml) calculation	TBV (ml) calculation
Equation 1	$\frac{\text{Ht (cms)} \times \text{wt (kg)}}{3600}$			Males 2740 ml/m ²
Equation 2	$\text{Wt}^{0.425} \times \text{Ht}^{0.725} \times .007184$	$(1486 \times \text{BSA}) - 825$	$1578 \times \text{BSA}$	RCV+PV



RESULTS

- Complete data available for 625 donors
- The difference of BSA with two equations 0.01m^2
- Mean difference of blood volume with the two equations was 252.4 ml

Descriptive statistics


Parameter	Range	Mean	SD
Age (years)	17-58	27.4	6.8
Weight (kg)	50-110	66.3	7.3
Height (cms)	144.7-200.6	169.4	5.4
BSA(m ²)equation 1	1.51-2.30	1.75	.104
BSA(m ²)equation 2	1.50-2.29	1.74	.102


TBV by equations

Parameter	Range	Mean	SD	SEM	95%CI	Correlation	Sig
TBV(ml)equation 1	4137.4-6302.0	4819.2	285.7	11.4	Lower 4796.7 Upper 4841.6		
TBV(ml)equation 2	3739.5-6222.2	4566.8	319.5	12.7	Lower 4541.6 Upper 4591.9		
Difference Equation 1-equation 2	248.4-802.8	252.4	64.6				
Pair (TBV by equation 1 and TBV by equation 2)		252.4	64.6	2.5	Lower 247.3 Upper 257.5 (95% CI of difference)	.983	.00

Percentage of TBV in Pakistani donors vs. blood donors in other countries

Country	Volume of donation	Percentage of Pakistani donors blood volumes/absolute volumes	
		Equation 1	Equation 2
UK average volume ²	450 ml	9.3%	9.8%
Maximum volume ²	450 ml + 45 ml=495 ml	10.2%	10.8%
Maximum volume with pilot tube sampling volume ²	495 ml + 30 ml= 525 ml	10.8%	11.4%
Turkey, Greece, Italy ²	350-400 ml	7.2%-8.3%	7.6%-8.7%
UK guidelines ^{3,5}	13% (max)	626.4 ml	593.6 ml
USA ⁴	15% (max)	722.8 ml	685.0 ml

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- The BSA calculated by equations showed difference of only $.01 \text{ m}^2$
 - The difference of means of TBV by two equations was 252.4 ml
 - t-tests for paired sample statistics showed that difference was significant
 - The two equations for calculating blood volume cannot be used interchangeably, but either can be used to calculate BSA
 - Predictive value of equation 1 is not known as it was not compared with the actual measured values while equation 2 has been compared

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- Difference of TBV with these two equations is significant therefore the one giving larger volumes can overestimate collection volume
 - recommendation of collecting larger volumes can compromise safety
 - Equation 2 provides wider safety margin because of TBV calculated being smaller
 - Actually closer to the actual measured volumes
 - Preferably adopted for calculation of blood volumes in our population (even for other uses)



- absolute donation volumes usually drawn from our donors do not exceed the 13 % limit by UK guidelines and 15 % limit by AABB, because the blood volumes are not different from European countries.

- The recommendation for blood donation volume for male Pakistani donors are:
 - 450 ml + 45 ml with additional volume of 20-30 ml in pilot tubes (same as for UK donors)

- This will meet the safety standards for donors and quality control parameters of component prepared

- The validity of these equations for calculating volumes in our population can only be done after measurements of RCV and PV by radionuclide methods



Follow-up studies to prove safety

- safety impact of recommended volumes in our study can be gauged by documenting number and nature of adverse effects of blood donation
- Adverse effects should be made reportable to a centralized authority
- Revision of guidelines can then be undertaken



- This data also cannot be extrapolated to female donors who constituted less than 1% of our donor population.
- Separate equations should be applied and formulate recommendations.



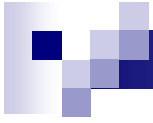
Recommendations

- The volumes of blood collected should be measured by using automatic weight sensitive devices.
- Not left to non standardized visual check for the adequacy of volume as is being done by majority of local blood banks.
- Impact of collection of this quantity of blood on iron stores of volunteer donors be studied.
- Frequency of blood donations and volumes collected per year, for Pakistani donors.



conclusion

- We should make policies after validation of evidence generated in other populations.
- Indigenous research is important to even question well established practices and should not be taken for granted.
- This study helped to assess the safety of donation volumes, for our male population as are being used in other countries.



Thank you