

## Quality assessment of donated blood in a tertiary health center blood bank services, UMTH experience

Dr. Usman Ali M. Abjah, Dr Modu Baba Kagu, Mr Saliu Idris, Dr Audu Abdullahi Bukar and Mr A C U Ezimah

Department of Haematology, University of Maiduguri Teaching Hospital  
Safe Blood for Africa Foundation Abuja.

### ABSTRACT

In Nigeria, blood transfusion practices have not been given adequate priority. Reliance of visual inspection of the donated blood bag for estimation of the blood volume collected is the practice in its hospital blood banks. This means patients in need of blood and blood products for transfusion could be receiving poor-quality blood. This study was designed to evaluate the activity of the blood banking services with the aim of ensuring that patients receive blood transfusion therapy that meets the WHO minimum standards and with attempts at improving the hospital's over all quality-of-care programmes. One important measure of quality is the safety of the blood supply. Three hundred bagged donor blood units collected at UMTH Blood Bank from August 2006 to January 2007 were prospectively analyzed. The weight of the donated blood containers and the average weight of pre-donation blood bags were taken and subtracted to get the actual weight of blood in the donor unit. The actual volume of the blood collected were calculated and separated into low volume units (300-404mls), normal volume units (405 – 550mL) range and over loaded units(>550mls). Agary, Colba and IDL were the blood containers commonly available at our health facility. The average weight of Agary, Colba and IDL donor bags were 104.2mg, 118.4mg and 124.5mg respectively. One hundred each donor bag typed was analyzed and 5.7% were found to be of low volume unit, 55.3% were normal and 39% were overloaded. The traditional practice of reliance on inspection at blood collection should be substituted with a standard scientific method using weighing balances and cut off flow devices. Since "poor quality" blood or blood component with its attendant consequences can easily be transfused. We recommend that the low weight bags red cells be used for adult patients but should not be applied in paediatrics. As for the overloaded bags, it should be discarded because of micro and macro aggregate formation.

**Keywords:** quality, blood, donation, weight and UMTH

### INTRODUCTION

Transfusion medicine has over the years evolved to assume a complex, sophisticated medical – technical discipline that aided or modified patient care.

Blood donation culture has not been fully imbibed in our society and homologous blood is usually in short supply in the blood banks with its attendant consequences in patient management<sup>1</sup>

Blood donation has potential benefit to the recipient but is associated with medico-legal consequences. In view of this, strict criteria have been adopted by most blood banks in sourcing for safe blood. The discovery of HIV/AIDS has added another dimension to the safety issues in blood transfusion and has therefore created further distance from the zero error principles of transfusion therapy.<sup>2</sup> However, well laid

out strategic defense measures have been mapped out in all transfusion settings geared towards provision of safe blood<sup>3</sup>.

Safe blood is one art that does not contain any transfusion transmissible pathogens, drugs, alcohol, chemical substances or other extraneous factors that might cause harm, danger or disease to the recipient.<sup>4</sup>

The provision of safe [safety in blood collection and use] will only be achieved through the development of detailed National blood policies, quality systems and procedures and a sustainable and effective donor recruitment programme based on voluntary unpaid blood donors, good laboratory and good manufacturing practices and appropriate use of blood.<sup>5</sup>

WHO and Nigerian National Transfusion Policy advocates that a prosperous blood donor should be voluntary. However, due to an inadequacy of blood supply in most of our center compared to the demand, other donor categories e.g commercial donor still thrives in an attempt to boost or maintain the donor pool or blood bank reserve capacities<sup>6,7</sup>

Blood is collected into a plasticized material that is biocompatible with blood cells and allows diffusion of gases to provide optimal cell preservation. Further preservation is enhanced by the quality of the anticoagulant preservative solutions. CPD-A1 is the commonly used anticoagulant in our blood bank settings to provide nutrients that maintain red cell viability, red cell enzyme and red cell function which makes it possible to preserve red cells up to 35 days<sup>8,9</sup>.

In an ideal practice, the blood container is placed on a scale, which may have a device to cut off the flow of blood when the container reaches a set weight indicating that the desired volume of blood has been collected. However, that is not the case with most blood banks in the developing countries.

The volume of anticoagulant solution is calculated to allow for collection of a particular volume of blood, which in the U.K. is 450±45ml. In the USA often 500ml, but in no case more than 10.5ml/kg including the additional volume of 20 – 30ml of blood which should be collected into the pilot tubes.

In some countries the volume collected is less than 450ml. For example, 350 – 400ml in Turkey, Greece and Italy and 250ml in some Asian countries such as Japan where donors tend to be smaller.<sup>10</sup>

It is our expectation that 450mls of donor blood is collected into the plastic bags. However, this bags been made of plastics has the tendency to expand.

Taking into consideration, the application of “common sense” judgement in determining when to stop collecting blood in our blood bank settings. It is for this reason, that the study was undertaken to evaluate the actual volume of the blood collected viz –a- viz the blood anticoagulant ratio and its attendant consequences on the recipient and shelf-life.

## MATERIALS AND METHODS

The safety of 300 bagged donor blood units collected with respect to, viability, shelf life and blood anticoagulant ratio at the UMTH blood banking facility

were prospectively analyzed. All the units at the time of the study were identified with their donor numbers, the bag type, and weighed with Mettler weighing balance [METTLER PE 3000, METTLER Instrument AG CH-8606 GREIFENSEE –ZURICH – made in Switzerland] and recorded.

Ten donor bags (plastic bag with 63mls of CPD-A1 anticoagulant) were weighed in each category of bag type and an average weight is determined. Then the actual weight of the collected blood was determined by subtracting the bag weight from the bagged blood weight. There after the actual blood volume was evaluated with the formula.

$$\text{Blood Volume} = \frac{\text{Expected bag weight} - \text{weight of bag}}{\text{Specific gravity of blood.}}$$

The unitary blood volume of blood in the blood container was recorded and separated into low volume units, normal volume unit [figures between 405 and 550mL i.e 450 or 500mL ± 10%]<sup>11</sup> and over those that exceeded the required volume. The data generated are analyzed using SPSS version<sup>11</sup>, 2002 statistical package and are presented in tables.

## RESULTS:

A total of one hundred bagged donor blood units in containers manufactured by Agary, Colba and IDL were studied. The average weight of the containers was 104.2mg, 118.4mg and 124.5mg respectively. The weight of blood from each donor unit was determined and the actual collected blood volume in each container was calculated and recorded. Based on the actual blood volume in each container; 17(5.7%) were found to be classified as low volume unit, 166(55.3%) fall within the required volume and 117(39%) were overweighed or over loaded.

Of the 17 that were classified as low volume unit, 1(5.88%), 10(58.82%) and 6(35.29%) were found in containers labeled Agary, Colba and IDL respectively. The 166 bags that fall within the normal collectible limit, 35(21.1%), 62(37.3%) and 69(41.6%) were found in containers labeled Agary, Colba and IDL respectively.

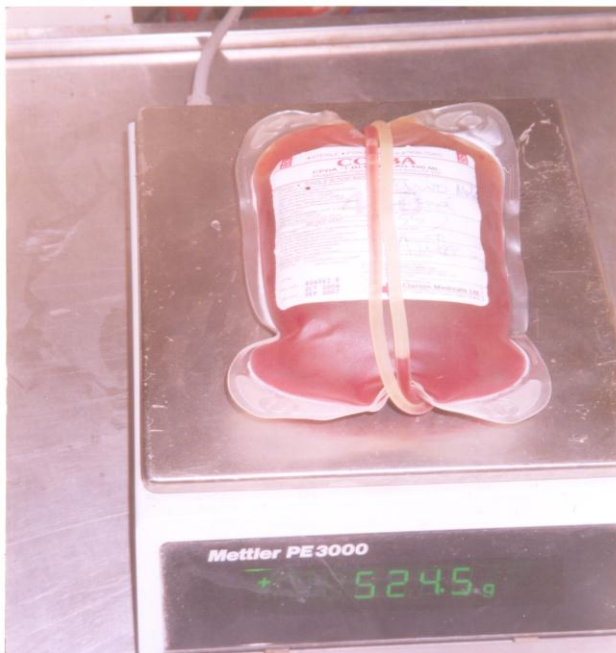
The 117 bags were classified as overweighed and this are found in bags tagged Agary = 64(54.7%), Colba = 28(23.9%) and IDL = 25(21.4%) respectively.

Table 1

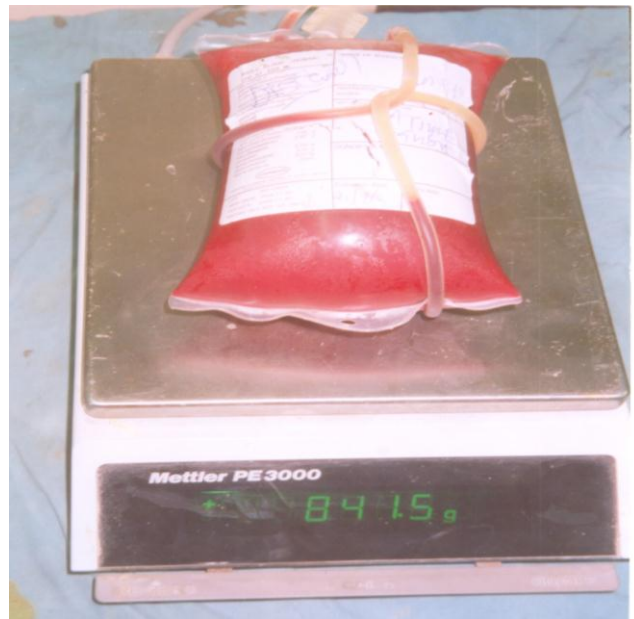
Bag Brand	Low Volume Units	Normal Blood Volume	Over-loaded	
Agary	01	35	64	100
Colba	10	62	28	100
IDL	06	69	25	100
Total	17(5.7%)	166(55.3%)	117(39%)	300

Table 11

Bag brand		Mean	SD	SEM
Agary	Overloaded	613.914	41.5773	5.1972
	Normal vol	516.466	25.3415	4.2835
	Low vol	327.400		
	Total	576.942	64.2363	6.4236
Colba	Overloaded	597.421	44.4031	8.3914
	Normal vol	502.594	31.3254	3.9783
	Low vol	367.430	32.7911	10.3695
	Total	515.629	73.8723	7.3872
IDL	Overloaded	590.364	42.4738	8.4948
	Normal vol	507.372	29.0198	3.4936
	Low vol	341.517	34.8758	14.2380
	Total	518.169	66.0751	6.6075



Underweight bag



Overloaded Bag

**DISCUSSION**

In Nigeria, blood transfusion services have not been a priority and because of this the safety of blood is a

concern for us all, moreso as blood is the most commonly given tissue and it's use has become an integral part of modern medical practice<sup>4,12</sup>.

Frequent lack of blood for transfusion in clinical setting is a major concern in most developing countries, not to mention the increasing need in oncologic setting<sup>13</sup> and the crude politicking which breeds thuggery. Most health facilities are under funded and therefore most requirements are not given desired attention. This under funding usually translates to poor quality services and blood banking services are not spared.

This work is targeted at the traditional practice of blood collection in our health facility. Where there is a complete reliance on inspection as a mechanism of quality control, this we believe could be counterproductive.

In this report, 117 [39%] of the donor unit collected [table1] were classified as overloaded and this will lead to alteration in mixture ratio of blood with the available anticoagulant in the container. Which means the quality of the blood that a patient may receive is of "poor-quality"<sup>9</sup>. Quality of the blood meant for transfusion is highly dependant on this ratio and therefore there is the need to protect it. Since the cell anticoagulant ratio will alter when excess red cells are collected in the overloaded bag over the anticoagulant available. This will translate to poor quality and will therefore affect the viability of the bagged blood because the cell fragility and red cell metabolism will be poor due to excess consumption of ADP. This undesirable alteration in the blood anticoagulant mixture has affected the quality of the blood collected, which will lead to the attendant macro and micro aggregate formation"

In consideration to the blood giving package available in our local market, the filters are of second generation. Therefore the formed macro clots are more likely to affect the rate of blood flow. These are as a consequence to the blockage by the poor quality of the second generation filters marketed. The micro clots will invariably maneuver through the filter to pass into the patient to cause transfusion related acute lung injury [TRALI] which is fetal.

In the overloaded units, there is excess blood volume collected and this is likely to have negative impact on the Extra-corporeal volume (ECV). By upsetting the ECV vis-à-vis the Total blood volume, the blood anticoagulant ratio is altered. The alteration theoretically should not exceed 15%<sup>11</sup>.

Among the small available pool of non-voluntary donors, most tend to donate frequently and they are likely to fall into the category of donors that have an increased tendency of rapidly migrating into iron deficiency status much earlier than they voluntary donors whose blood donation is controlled.

17[5.7%] of the units collected in the study, were tagged low volume units (300 to 404mL) or is under weighed and should be labeled as such. Ideally, their blood should be discarded, but due to the decreasing number of blood donors in our communities. Their units have found a place for clinical application to patients who require transfusion. We are forced to use their red cells for transfusion, due to our peculiar circumstances. Especially where alternative blood supply are not readily available e.g in rare blood group patients and in life-threatening emergencies.

Equally the fear to use the plasma in the low volume bags (because of excess anticoagulant in the donated blood) is more pronounced in the paediatric setting. The plasma on the order hand should be discarded because of anticoagulant/ plasma ratio is not balanced. Therefore, there are a lot of doubts generated from the anomaly as to the use of platelet concentrates prepared from such units. Because there is excess of anticoagulant available in the container and this when transfused to a neonate will lead to citrate toxicity<sup>14,15,16</sup>. Citrate toxicity could manifest as hypocalcaemia with symptoms of muscle paralysis, twitching, anxiety and in the more severe situations seizures and cardiac arrhythmias will prevail<sup>17</sup>.

Even though small volumes of blood are administered in neonates, nevertheless it may amount to a massive transfusion in relation to the patients' blood volume. It is for this reason that supplemental calcium is administered during exchange transfusion.<sup>16</sup> The could be a potential treat to citrate toxicity in the adult, when low volume units of whole blood donated are the source of plasma and platelet concentrate. Considerable amount of the excess citrate that is available in the whole blood unit has the tendency to travel with these products during the component preparation. Unfortunately larger volumes of these products are usually required in transfusion to achieve haemostasis.

Now that the federal government is upgrading the tertiary health institutions, with supplies of computers [to generate labels] may be acquired for use in our blood banking services. So the incorrect weighted [overloaded and under weighed] bags are most

expectedly to be rejected and this could be a source of waste of a scarce resource.

Comparing the expansible nature and performance of the different bag types in terms of volume it can accommodate. Table 1 gives a crude assessment of the defects in manufacturing process of all the available blood bags in our community. Though reliance on inspection as a mechanism of quality control is discredited long ago, however it remained the practice in our health facilities. This unfortunate scenario has translated to some patients receiving a product that is of less desirable quality. Since we have limited quality control measures to detect a "poor quality blood" other than visual inspection before it is transfused. We believe application of these measures of quality steps will help in the control of wastages. Therefore we recommend that the contemporary approach to quality by the use of prevention is one option, standardization of manufacturing process of the blood bags be effected and that our blood collection processes be improved upon by making available cut off flow devices or a standard weighing balance.

#### CONCLUSION AND RECOMMENDATION

In the context of inadequate facility required to enforce safe transfusion practice, thus we have deemed it necessary to review the current practice of blood collection with a view to implement the newly enacted National blood transfusion policy and the operational guideline for the implementation of the policy.

#### REFERENCES

- 1) Olaitan PB, Onah I I, Ogbonnaya I S. Preliminary reports of autologous blood transfusion in a plastic surgery unit. *Tropical Doctor*. 2006; 36: 20-21.
- 2) Fiebig E, Safety of the blood supply. *Clin Orthop* 1998; 357: 6-18.
- 3) Ahmed SG. Laboratory strategic defense initiatives against transmission of Human Immune deficiency virus in blood and blood products. *Nig Postgrad Med Journal* 2003; 4: 254-259.
- 4) WHO and International federation of red cross and red crescent societies. *Safe Blood starts with me. Blood saves lives*. 2000.
- 5) Mvere DA. A strategy for blood safety in the African region. *Africa Health* 2002; 24(5): 9-11.
- 6) WHO. The appropriate use of blood and blood products, In: *The clinical use of blood*. Geneva 2001; 3-7.
- 7) Guidelines on Appropriate use of blood products for Nigeria. The National Blood Transfusion Service of the Federal Ministry of Health. Federal Ministry of Health. Lagos. 1991.
- 8) Benesch R, Benesch RE. Intracellular organic phosphates as regulators of oxygen release by hemoglobin. *Nature*. 1969; 221: 618-622.
- 9) McCulloch J. Preparation, storage and characteristics of blood components and plasma derivatives. In: *Transfusion Medicine*. Elsevier Churchill Livingstone. PHILADELPHIA. 2005: 77-109.
- 10) Blood donors and the withdrawal of blood. In: *Blood Transfusion in clinical medicine* [Klein HG, Anstee DJ eds.] Blackwell Publishing. Bristol. 2005: 1-18.
- 11) McCulloch J. Blood donors medical assessment and blood collection. In: *Transfusion Medicine*. [McCulloch ed]. Elsevier Churchill Livingstone. Philadelphia. 2005. 53-75.
- 12) Federal Ministry of Health National Blood Transfusion Policy. Abuja. 2000
- 13) Fasola FA, Okunade MA, Abjah UMA, Quality assessment of platelet concentrate prepared at a tertiary centre in Nigeria. *African Journal of Medicine and Medical Sciences* 2002; 31: 337-339.
- 14) Swank RL. Alteration of blood on storage: measurement of aging platelets and leucocytes and their removal by filtration. *N Engl J Med*. 1961; 265: 728-730.
- 15) Ukaejiofo EO. Blood transfusion and management. In: *Blood transfusion in the tropics* [Ukaejiofo EO ed] 1<sup>st</sup> edition. Salem Media, Ibadan 1996; 101-121.
- 16) McCulloch J. Complications of Transfusion. In: *Transfusion medicine* (McCulloch J ed) Elsevier Churchill Livingstone. 2005; 381-406.
- 17) Olson PR, Cox C, McCulloch J. Laboratory and clinical effects on the infusion of ACD solution during Platelet pheresis. *Vox Sang* 1977; 33: 79-87.