

Prospects and Challenges of Cord Blood Transfusion in Nigeria

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Abstract

Cord blood (collected from the cord and placenta at birth) is a very rich source of fetal haemoglobin, CD34+ haemopoietic stem cells, cytokines and platelets. Fetal haemoglobin, in cord blood erythrocytes, has been used to treat severe anaemia has been reported to have an anti-malarial effect. Nigeria has a wide gap in the provision of safe blood through the WHO approved voluntary and altruistic donation, cord blood transfusion could play a significant role in bridging this gap. Current cord blood collections are a relatively low in volume and this is a potential disadvantage of cord blood transfusion. This can be overcome by multiple transfusions and also by future improvements in collection technology. The National Blood Transfusion Services of Nigeria (NBTS) and other stakeholders need to further evaluate and exploit this life saving opportunity through a coherent plan and infrastructure for the creation of a clinically useful cord blood donation programmed across Nigeria. This would result in a massive improvement in the general health and reduce morbidity and mortality in Nigeria. An implementation process is proposed for the introduction of cord blood transfusion in Nigeria.

Keywords: Cord Blood Transfusion; Nigeria; CD34+

Introduction

An estimated 13 million units of donated adult blood worldwide are not tested for human immunodeficiency or hepatitis viruses, and in some developing countries 80 percent of the blood supply comes from paid donors or re-placement donors (family friends or acquaintances) even when the virus-infected population is high [1]. Concerns about the safety and adequacy of the blood supply have fostered twenty years of global research into the so-called "blood substitutes" among them the oxygen carriers based on modified haemoglobin. However, there are still efficacy and safety issues surrounding the use of artificial blood substitutes in humans [2]. There are currently numerous sources of stem cells embryonic stem cells derived from human blastocysts: These have attracted considerable media attention and are pluripotent stem cells. Human cord blood is widely used as a source of CD34+ haemopoietic stem cells for transplantation in the treatment of blood disorders [3]. More recently, studies on cord blood have been fo-

cusing on transplantation in cases of malignant disorders and in the current and future uses of cord blood in regenerative medicine [4].

The idea of using placental blood as a transfusion product was first described 80 years ago [5]. Since then, many more studies have assessed the potential of cord blood as a transfusion product especially for autologous use in the newborn [6-8]. This paper discusses the blood transfusion pattern and the feasibility of cord blood transfusion in Nigeria with a major focus on patient safety and sustainability considering the limitations of Nigerian infrastructure and National resources.

Methodology

Prospects

Studies by Bhattacharya [2] have shown considerable clinical utility of cord blood transfusion in the treatment of malaria and associated anaemia and also the resolve emaciation in HIV-positive

patients. The potential beneficial effects of a rise in CD34+ cells in patients suffering from malignancy related anemia has also been described [9] along with the use of cord blood transfusion in thalassemia [10] and in the treatment of anaemia in diabetes [11], rheumatoid arthritis [12] and tuberculosis patients [13]. A further paper from this author reported a transient engraftment of CD34+ cells in some leprosy patients transfused with cord blood thus highlighting a potential risk of graft versus host disease if immuno-suppressed patients are given cord blood [14].

To maximize the benefits of cord blood transfusion, the National Blood Transfusion Service (NBTS) of Nigeria should promote the application of internationally accepted principles of blood component therapy [15] including autologous techniques [16].

These reports suggest that hospitals could use umbilical cord blood, collected at the time of birth, as a supplement to and even possibly to replace, adult blood donation.

The population of Nigeria is approximately 167 million and typical of a developing country, there is a high birth rate. Nigeria is the most populous African nation with a ready supply of umbilical cord blood that is currently discarded as medical waste. In addition to treating anaemia, a major potential advantage of cord blood transfusion in malaria endemic zones such as Nigeria is the potential role of limiting the growth of parasites in anaemic patients with malaria because of the inhibitory effect of fetal haemoglobin on intra-erythrocytic proliferation of malaria parasites and/or attenuation of parasite virulence by weakening the *in vivo* cyto-adherence of parasitized erythrocytes [17,18].

Challenges and recent developments

Safety and sterility of transfused cord blood

One of the primary concerns when using cord blood as a transfusion product is the relatively high potential for bacterial contamination at the point of collection [19] and the presence of clots in the cord blood [20]. Improved sterile collection methods and red blood cell storage media have since allowed cord blood to be developed as a stable transfusion product [21]. The proposition of using umbilical cord blood as a transfusion product is therefore becoming a clinical reality [22].

Nevertheless, further work is needed to establish whether the microbial contamination rate recorded can be reduced and whether or not one venepuncture could improve sterility with the likely reduction in volume collected volume [23]. Sterility is optimal when cord blood is collected when the placenta is *in utero* [24]. The quality of cord blood collected in Lagos, Nigeria has been shown to be comparable with established international centres [25].

Storage of cord blood following collection

Cord blood banking, for use as a transplantation product, has now been adopted globally [26]. The most impressive use of cord blood as an allogeneic transfusion product has been reported many times by Bhattacharya and colleagues in Calcutta, India. They have described the beneficial action of fetal haemoglobin in cord blood transfusion [27] and the use of cord blood as an emergency transfusion product in a developing country [28]. Recently, another group in Kenya have shown that cord blood can be stored for up to 35 days with similar and acceptable haemolytic kinetics to that of adult whole blood at 1 - 4°C [29].

Low collection volume of cord blood

The problem of low collection volume of cord blood still persists [30] when using traditional collection methods and has an impact on any proposed use of cord blood for transfusion purposes. Nevertheless, *ex utero* placental perfusion technology is being developed which can considerably increase the volume of cord blood collected [31,32]. While the low volume collection may possibly pose a problem in adult transfusion such a problem would not arise in neonatal and childhood transfusions where relatively small volumes of blood are needed [33].

Ethics of cord blood collection and shortage in the supply of properly screened blood

Scientific societies, ethical commissions and similar institutions have highlighted the ethical problems related to umbilical cord blood collection and storage for transplantation [34]. These include informed consent, ownership, medical indications, claims related to medical benefits, allogeneic use versus autologous use, legal frameworks, quality assurance, traceability, personal data protection, relationships between patients, doctors and umbilical cord blood banks and relationships between recipients and umbilical cord blood banks [35-37].

The current situation in Nigeria is that of a shortage of adult blood donation partly because of a poor infrastructure for donation [38] and the problem of occult infectious disease means that those units donated must be used with extreme caution [39].

It is therefore essential to stop the wastage of the cord blood in Nigeria and utilize it to supplement the inadequate adult donor supplies. Superstitious beliefs of the pregnant women have to be addressed through proper health education and counselling [40].

Pattern of blood donation in the Nigerian blood transfusion service and hospital collection centres

At present, blood transfusion in Nigeria is highly fragmented, hospital-based and dependent on family replacement and com-

mercial donors [41]. In Nigeria there is a national policy towards provision of adequate and safe blood supply at the highest level; however, even with ample funding, the development of a national blood transfusion program will require a sustained effort over many years [42].

Hospital based collection, either through paid donors or family replacements are still the major sources of blood in Nigeria [43]. Aminu Teaching Hospital (AKTH), Kano for instance, were able to collect only 11,003 units of blood through family replacement, voluntary and other donations between 2004 and 2006 [44]. Between 1986 and 2006 University of Benin Teaching Hospital (UBTH) collected only 160,431 units [45] while Ahmadu Bello University Teaching Hospital (ABUTH) and University of Maiduguri Teaching Hospital (UMT) collected 6,027 units of blood between 1999 and 2006 and 49,996 units from 1984 to 2006 respectively [46].

Two of the 15 NBTS regional centers in Jos and Kaduna collected 2,989 units between 2008 - 2010. The NBTS is the only reliable source of safe blood, from voluntary and altruistic donors as approved by WHO.

The existing gap in safe peripheral blood transfusion services in Nigeria

The amount of adult peripheral blood collected in Nigeria for transfusion is far below the recommendation of the World Health Organization (WHO). WHO state that 10 percent of a given population should donate once a year to meet National requirements. Approximately 8 million units of peripheral blood are needed in Nigeria annually but at present 1.6 million units are collected. The general public are becoming more aware of the importance of blood donation [46] but they have no knowledge at all about cord blood transfusion.

It is evident that between 2003 and 2007, among the 14 PEP-FAR countries, Nigeria has recorded the widest gap in providing safe peripheral blood for transfusion [46]. The gap is mainly due to an imbalance in the dynamics of peripheral blood donations and blood utilization across the Nigerian population. The dynamics are typically characterized by strong donor inertia, which is largely attributable to ignorance, superstitious beliefs, and apprehensions relating to blood donation that has now become compounded by fear of pre-donation test for HIV [47]. The donation gap created by the donor inertia is accentuated by high transfusion demands associated with high incidence of maternal and childhood anemia as well as anemia of chronic diseases due to high prevalence of tuberculosis, HIV/AIDS and other chronic tropical diseases in the Nigerian population. This huge gap in the supply of blood in Nigerian blood transfusion centers calls for an alternative source of blood needed by patients suffering from HIV, tuberculosis, malaria, trauma, malignancies, obstetric complications, leprosy and several other severe anemia patients. Nigeria definitely has an advantage in availability of cord blood considering the high delivery rates and

at present all cord blood in Nigeria is discarded as medical waste or the placenta is used in religious or ethnic ceremonies.

Implementation process

The successful implementation of cord blood transfusion technology will need time, investment, commitment from midwives, laboratory personnel, and physicians and both pre-service and in-service trainings. The result will be a much more reliable transfusion process in Nigeria which will save money and lives and set an example to the rest of the World. They key processes which are required are:

- To seek political and financial support from the Nigerian Government.
- To include cord blood transfusion in Nigeria's National blood transfusion policy, National laboratory policy and National (Health) strategic plan.
- To seek additional funding and support such as from the WHO, NGO's and private investors.
- To educate midwives and physicians on the importance of collecting cord blood for transfusion.
- To educate end user physicians and surgeons on the use and importance of cord blood transfusion.
- To educate pregnant women on donation of their cord blood for transfusion. This will take time and effort and will need to challenge superstitions and beliefs surrounding childbirth, this may be the biggest hurdle to overcome in this project. This will require written information, cord blood transfusion discussed on the radio/tv and cord blood donation for transfusion information on the internet. It must be made very clear that cord blood donation for transfusion is an altruistic act.
- To develop informed consent to donate cord blood process driven by midwives and physicians seeing pregnant women in the second or third trimester.
- To identify suitable delivery units for cord blood collection for transfusion. These need to be delivery units associated with a major hospital and with easy connection with the Nigerian BTS.
- To arrange for the supply and provision of cord blood collection kits in all hospitals where cord blood is to be collected and the transport of the cord blood to processing centres i.e. NBTS or purpose built units in large hospitals
- To train maternity unit delivery staff in the aseptic collection of cord blood after the baby is born and the placenta is still *in utero*.
- To enable the collection of maternal blood for infectious disease screening when the baby is born. This must be a rapid and definitive screening process for HIV, Hep B, Hep C and syphilis ideally using multi-plex Nucleic Acid Testing (NAT) or Multiplex Beads Assay (MBA). Serology testing is too slow and would not completely exclude HIV. The safety of those patients receiving cord blood transfusion is paramount.

- To enable cord blood testing for bacterial contamination (using existing blood culture technology) to ensure that no bacterial infection results from cord blood transfusion. Such cultures typically take up to 48 hours during which time the cord blood must be kept in quarantine and not released for transfusion until a clear blood culture has been received. Any contaminated cord blood must be discarded.
 - To enable the processing and grouping of cord blood for transfusion (this should follow the existing infra-structure in the Nigerian BTS).
 - To enable the distribution of cord blood for transfusion via existing Nigeria BTS infrastructure and increased infrastructure if needed.
 - To develop a Quality Management System to ensure the quality and safety of all cord blood collected and transfused. This will include the validation of all processes and procedures related to cord blood collection and transfusion.
 - To create a system (ideally a clinical registry) whereby the safety and efficacy of cord blood transfusion and the related data created in Nigeria can be collated and reported.
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Conclusion

Cord blood transfusion will tremendously contribute to bridging the identified gap in safe blood supply in Nigeria. The need for the NBTS and the Department of Public Health Federal Ministry of Health and other stake holders to consider and learn from cord blood transfusion in three resource-limited countries (India, Kenya and Ghana) cannot be over emphasized.

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