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Recent Trends and Practices in Blood Transfusion

Dr. Anil Mohan Rao.S[1] (MD), Dr. Anshoo Agarwal[2] (MD)

[1]Assistant Professor of Pathology Faculty of Medicine Northern Border University Arar Saudi Arabia

[2]Professor of Pathology Faculty of Medicine Northern Border University Arar Saudi Arabia

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Corresponding author: Dr. Anil Mohan Rao.S
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Abstract

Blood Transfusion is one of the most important, Potent and Critical therapeutic tools in the realm of Clinical Management of Patients. Modern Blood banking involves carefully coordinated sophisticated and integrated teamwork comprising of well experienced Technicians, Physicians along with the Donor/Patient support. It consists of latest Machinery and infrastructure to cater to the needs of patients, along with regular internal / external Audit, quality control and Calibration of Machines, which is vital to the efficient functioning of Blood Bank and delivery of smooth, accurate results. The aim of this study is to explore the various latest aspects of Blood Banking and reinforce the knowledge of Medical Community

Introduction

The History of Modern Blood Banking dates back to the discovery of Blood Groups by Karl Landsteiner in the year 1901. It paved the way for classification of Blood Groups into Four Main Groups, facilitating the compatible blood transfusion and minimizing/eliminating the mismatch/ adverse reactions associated with Blood Transfusion. Latest Literature also suggests the association of various diseases with specific blood groups[1] .Studies have suggested the value of Computerized blood bank management information system in the accurate and smooth functioning of Blood Bank over the traditional system of manual method [2].The Purview of Blood Bank can be extended by provision of facilities for storage of Cord Blood by employing new techniques [3].Recent developments in Blood Grouping and Typing includes advancements in Molecular Typing ,and techniques such as Microarrays, Quartz Crystal microbalance and Lateral flow assays can minimize problems in grouping and typing [4].The principles and practices of Blood Bank should abide by the Code of Ethics framed by International society of blood transfusion[ISBT][5].The role of Blood Bank has gone beyond the routine collection and dispensal of blood and its products to include special activities such as Apheresis and Stem cell collection ,Typing studies for HLA system, Cryopreservation and Infusion[6]. In recent times Autologous Blood Transfusion has proved to be safe and efficient alternative to routine blood transfusion ,as it can overcome many barriers associated with latter[7].The introduction of Automation in Blood Bank has

improved the overall function in terms of blood donation, component collection and processing ,Testing of Blood groups/Types, Cross Matching, Automated Molecular method of serological screening for Infections and identification of blood bags .Automation is feasible in Large Blood Banks with heavy work load [8] .In addition New Techniques has proved their efficiency in screening for Red cell Allo antibodies[9]. Techniques like SPRCA [solid phase red cell adherence] has proved to be of utility in identification of circulating antibodies and can serve as an Adjunct to Direct Coombs Test[10].

Comparative Trends of Blood Transfusion Across the World

s.no	Type of common transfusion	Indications	North America	Africa	Asia	Europe	South America	Oceania
1	PRBC[11]	Nutritional deficiencies	√	-	-	-	-	-
2	Whole Blood[12]	Acute Bleeding,Sickle Cell Anaemia	-	√	-	-	-	-
3	Whole Blood[13]	Nutritional Anemia,Hemolytic Anemia	-	-	√	-	-	-
4	Whole Blood[14]	Road Traffic Accidents[RTA]	-	-	-	-	-	√
5	PRBC[15]	Trauma related emergencies	-	-	-	√	-	-
6	PRBC[16]	Anaemia,obstetric emergencies,haemoglobinopathies	-	-	-	-	√	-

Discussion

There are various components that can be extracted from whole blood ,with use of different equipment in blood bank .The process of blood separation and collection is termed as Apheresis, which according to type of component can be Erythrocytapheres is [seperation and collection of red cells], Leukapheresis[separation and collection of white blood cells], Plateletphers is [separation and collection of platelets],Plasmapheresis[separation and collection of plasma][17].Plateletpheresis is of two types single donor platelet, random donor platelet .Single donor platelet is obtained directly from platelet pheresis machine and can raise platelet count by 30,000,whereas random donor platelet is prepared from whole blood by separation and can raise platelet count by 5000 for each unit respectively[18].One unit of PRBC should raise haemoglobin by 1gm//dl and is indicated when haemohlobin is less than 6gm%[19]. Cryoprecipitate is a product of fresh frozen plasma which is thawed and sediment is collected, for use in severe bleeding, disseminated intravascular coagulation, as it is rich in factor 8 and fibrinogen, which raises fibrinogen by upto 10mg/dl[20].Granulocyte concentrates are obtained from Apheresis machine and is indicated for short term in patients with severe infections with low granulocyte levels who are unresponsive to antibiotics of choice[21].The type of transfusion related diseases detected in blood bank varies in accordance with region across the world. In a study from university hospital from India prevalence ranged from 0.5% to 0.25 % ,with HIV as the fore runner and syphilis as the last[22].In another large retrospective study from teaching hospital in India it was found that prevalence of HIV is 0.46% and syphilis is 0.12% suggesting the role of stringent public health measures taken for the decreased trend in these diseases while HBV infection still remains as a problem to be dealt with[23].In a study from Qatar it was found that prevalence for HCV is relative high [0.6%] ,while for Malaria it is [0.20%],and HTLV infection prevalence showed an increasing trend[24].In another study from Saudi Arabia low prevalence was noted for HBV and HCV when the donors were screened by combined

serological[for antibody detection]and Nucleic Acid Detection [for Antigen detection] pointing to the effectiveness of this strategy in donor screening[25].In a review study from a premier institute in India to assess the problems faced during Covid pandemic by blood banks and the recommended steps to overcome these difficulties has revealed the following deficiencies [Blood and its products , staff/donor availability and safety, convalescent plasma ,consumables],which would be overcome by early planning at start of pandemic ,adequate sterilization of staff /donors along with use of PPE , proper disposal of blood bank waste following the covid norms ,involvement of NGO[26] .Study from USA regards to preventive measures adopted during Covid pandemic in blood banks has suggested that all blood banks should adhere to FDA regulations in place for Covid control and also for asymptomatic possible Covid donors screening is recommended to rule out Covid 19 diagnosis for blood bank safety[27].Cord blood use has revolutionized the principles of transplantation especially as an alternative to haematopoietic stem cell transplant, with its ready to use availability ,access to wide population and long term availability. The technicalities and quality control should be followed stringently for better outcomes .The technique of cord blood collection involves cord clamping and aspiration ,with an ideal sample consisting of 20-64 CD 34 cells per micro litre as the CD 34 gives the yield of CFU ,it is important to maintain this count by Flow cytometry along with temperature maintenance of -130^0 c.In addition tests should be performed to screen for infections and genetic diseases along with tests for identification such as HLA,ABO ,gender[28] .In a study from Brazil about outcomes and deaths in transfused patients ,it was found that patients who were admitted in hospital, with underlying conditions ,those who were given multiple transfusions and with varied components along with increasing age were the determinants with a relative mortality of 24% and Neoplastic disease accounting for major indication [28%] ,while obstetric causes is least [10%][29] .In addition a study from USA about effective reduction in the quantity of transfused units by thoughtful measures in blood bank such as imparting patient knowledge ,BPA [best practice advisory],computerized modifications has yielded desired results in terms of decreased transfusion burden on blood bank[30].The role of Audit in blood bank functioning is emphasized by the fact that it has significance in quality control which improves effectiveness of the staff and overall functioning of blood bank ,as was proved by study in USA where in Q probe study for Audit involving RBC transfusion was conducted which concluded that compliance was 69% which could further be improved by participation of team consisting of pathologist and transfusion specialist[31].In view of the most commonly transfused product ,guidelines were framed for RBC transfusion by College of American Pathologists[CAP] which stated indications as Acute[surgical ,Non surgical] or as Chronic Anaemia .For Haemoglobin less than 6gm/dl RBC transfusion is indicated ,while for Haemoglobin between 6-10gm/dl ,it is indicated if patient has underlying medical conditions ,and for Hemoglobin 10gm/dl or more it is not indicated, while in case of bleeding /loss of blood upto 30-40% of blood volume ,Crystalloids /Volume expanders are given in a healthy person without underlying medical conditions ,while if blood loss is greater than 40% RBC transfusion is definitely administered[32].Phlebotomy is a procedure that involves withdrawal of blood for diagnostic[peripheral smear examination and for other lab work up] or therapeutic purpose[Polycythemia vera ,Haemochromatosis, Porphyria, HbSC disease] .The clinician /Transfusion specialist who is performing it should carefully balance the indications and contraindications ,weigh the risks and complications[33].Transfusion related

incidents can be transfusion reactions ,infectious in nature. In a large study from India it was found that transfusion reactions accounted for 0.27% out of which 0.19% are allergic while 0.036% is febrile non haemolytic transfusion reactions. Careful monitoring is mandatory to overcome these problems[34]. A study on implementation of quality control measures in blood bank has suggested use of Standard Operating Procedure[SOP] in implementation of quality control in Blood Bank starting from collection of blood and its issue which include its location space , amenities , training of personnel ,the instrumentation and its periodic maintenance as per governing body rules and adherence to rules and regulations of drug control organization[35].Study conducted regarding new emerging infections in blood bank and their detection and prevention of transmission has suggested the use of Pathogen reduction technologies in neutralization of various pathogens such as Ebola virus, Hepatitis E,SARS -COV 2 ,MPOX using Mirasol PRT system for blood safety, which is based on a photochemical method involving riboflavin and UV light[36].Various studies has presented the link between blood groups and different diseases, such as an association exists between AB group and Cognitive impairment along with life style diseases and increased incidence of smallpox and E. coli and salmonella infections ,while O group show risk of various infections such as Kochs, Small pox ,Cholera, Plague and Group A is linked with risk of Pseudomonas and Small Pox ,Group B shows preponderance for gonorrhea, tuberculosis, and Streptococcus pneumoniae, E. coli, and salmonella infections. Blood type A has propensity for various GIT and genito urinary cancers[37].New emerging and endemic infections such as Zika virus, trypanosomiasis, leishmaniasis, filariasis ,malaria should be tested in blood bank in patients as per their geographical locations using combination of serological and direct microscopic tests [38]Recent advances in Artificial /synthetic blood has put forward two products ,HBOC, S [Haemoglobin oxygen carriers],Substitutes based on Perfluorocarbons .These products perform the function of Haemoglobin but has draw backs in addition to advantages of easy avalilabilty, no storage ,no donor screen .Draw backs for HBOCS are limited shelf life in body [20-30 hours]and generation of free radicals with associated injury ,while those for Perfluorocarbons has risk of accumulation in reticuloendothelial organs, these problems could be overcome by recombinant modified Haemoglobin[39].Evaluation of sterilization and waste disposal from Peru using Bowie & Dick tests and biological indicators based on Geobacillus stearothermophilus spores in Autoclaving has revealed a compliance rate of 80% and 90% respectively[40].

Conclusion:

Blood bank management is achieved by combination of factors such as well spaced, equipped and trained personnel with periodic review of functioning by Audit and quality control.

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