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Current concept of blood bank organisation and planning: A Review

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Abstract

This paper discussed current issues in blood banking .Blood bank is a unit where blood and blood component are screened, donated, stored and processed for blood transfusion to the patients who need them for sustainability of their life. It is a unit responsible for all activities that lead to the preparation and transfusion of suitable blood products. Blood bank has to be located in a central place easily accessible preferably in a ground floor to all department and existing services of the hospital. The paper covered the following areas; location and design, reception room, donation room, donor rest/ refreshment room, screening unit, the laboratory, preservation and Storage, blood bank records, haemovigilance and some other concepts.

Keywords: Current concept, Blood, Blood bank, Blood bank organization, Planning

Introduction

Blood banks is a compact unit where blood accepted from donors, are processed, stored and finally issued to needy patients on recommendation of doctors (Gupte, 2000). It is a unit responsible for all activities that lead to the preparation and transfusion of suitable blood products. Donor recruitment, blood donation, processing and storage are the areas covered under it (Gupte, 2000). With the development in science and technology, the blood banking which involves deposit, saving and withdrawal like others banking system, developed into an established bio-economical systems to economize the scarce resource blood for useful application to serve the needs of patient (Zwijewski *et al.*, 1982).

Organisation can be stated as a structure while planning is the function pervading all levels of organisation. Organisation is the systematic bringing together of interdependent parts to form a unified whole through which authority, coordination and control maybe exercised to achieve a given purpose. For any organisation, there must be some clear-cut function through which it can achieve its goals. In blood bank, its main function is to collect blood and blood product(industrial), to store the blood and blood product and issue the blood and blood product: banking, reporting on certain test procedure: investigating, and clinical consultancy as and when requested: consultative

i Location and Design

The location of blood bank should be situated in hospital premises and should run independently both

technically and administratively (Gupte, 2000). Blood bank has to be located in a central place easily accessible preferably in a ground floor to all department and existing services of the hospital. It will have separate entry and exit with wide corridors and waiting space in other to reduce traffic congestion. Laboratory and other rooms must be spacious though with minimal public entry so that there is no interference in the work of the scientists and doctors (Dutta, 2006).

ii Reception Room

The reception room should be quite spacious to accommodate a number of donors and patients, with proper sitting arrangement. It should be well ventilated with facilities like at least 2 registrations counter one for particular donors, and the other for registering particular patients. A doctor's cabin where proposed donors are examined and declared fit or unfit for donation. It should also include a small side laboratory for determining haemoglobin percent of donor, and various laboratory parameters, which may make the donor, unfit for donation (Gupte, 2000).

iii Donation Room

This room must possess comfortable beds for donors, sterile equipment for bleeding donors, a refrigerator and resuscitation equipment. It should also be comfortable and properly air-conditioned (Gupte, 2000).

iv Donor Rest/ Refreshment Room

This room should be air-conditioned with comfortable beds and proper seating arrangement. In the donors' rest room, the donors are served with light refreshment with a close observation of the donor after blood donation. This is to ensure safety and adequate recovery of the donor (Gupte, 2000).

v Screening Unit

Screening unit in the blood bank is a private room where discussions with those wishing to donate blood are made. Potential donors must be assured that any personal information disclosed will remain confidential (Cheesbrough, 2004). When prospective donors enter the screening unit in the blood bank, they are asked to read educational materials. This information contains information on the risks of infectious diseases transmitted by blood transfusion. After reading, donors can elect to leave at this point (self-deferral). But prospective donors who do not self defer proceed to the next step: giving a detailed health history. The history is designed to ask questions that protect the health of both the donor and the recipient (Maureen, 2006).

The donation process includes an abbreviated physical examination that includes checking the blood pressure, pulse and temperature. Anaemia is also tested for. The prospective donor who passes through these steps proceeds to the actual whole blood donation process, which takes about 20 minutes. In the screening unit, a donor can be deferred if he fails the basic eligibility procedures (ARC, 2007; Cheesbrough, 2004; Maureen, 2006).

vi The Laboratory

This is a very important part of the blood bank that should be handled by an experienced laboratory scientist. The laboratory should be spacious, provided with refrigerators and proper air-conditioned. Tests like grouping of recipient blood, proper labelling of the donated blood, cross matching of the patient's blood against donated blood should be carried out here (Gupte, 2000). Tests for the human immunodeficiency virus (HIV), malaria parasite, hepatitis and syphilis, are also carried out in the laboratory (Dutta, 2006). Blood may also be tested for additional infectious diseases such as West Nile virus, when and where these diseases are prevalent.

vii Preservation and Storage

There should be a room for deep freezing refrigerator to preserve blood and blood products. This keeps the blood in a good state until required for transfusion. Separate areas should be reserved for storing tested and untested blood and blood products. No food should be stored in the refrigerator and freezers (Cheesbrough, 2004).

viii Blood Bank Records

This is a part of the blood bank that has the record of donors, which include one for the relative donors and the other for voluntary donors. It also an issue register stating when and to who blood was issued to. Blood stock register should be separate for various groups of blood, plasma and other products and register for requisitions indicating a formal request for blood. Blood grouping and cross matching, ABO and Rh typing of OPD (out-patient department) and ward patients, hepatitis reports and record also have its own record books. There should be proper colour labelling

of blood collected by blood bank. The attendance register for all blood bank staff is present in this section of the blood bank (Dutta, 2006; Gupte, 2000).

Haemovigilance

Haemovigilance can be defined in a number of ways. However, National Blood Transfusion Service has chosen to adopt the Council of Europe's definition which states that haemovigilance is "the detection, gathering and analysis of information regarding untoward and unexpected effects of blood transfusion" (NBTS, 2007). According to the French law of 4th January 1993, the haemovigilance system is "a set of organised surveillance procedures from the collection of blood and its components to the follow-up of recipient aimed at collecting and assessing information on serious adverse or unexpected events or reactions resulting from the therapeutic use of labile blood products and epidemiological follow-up of donors to prevent their occurrence and reoccurrence".

Haemovigilance is a "quality process" with the intention to improve quality and increased safety of blood transfusion, taking into account that haemovigilance covers and surveys all activities of the blood transfusion chain. Its aim is to prevent occurrence or reoccurrence of adverse transfusion events (EU directive 2001). The incidence of adverse effects of blood reactions and events has decreased significantly due to greater attention given to all stages of blood transfusion. A statement from the Irish Blood Transfusion Unit has it that although the preparation, processing and testing of blood in collection centers is under strict control worldwide, there is little information on the current safety of the process from pre-transfusion/sample collection to the administration of the unit at the bedside .Hence, Haemovigilance Programme was implemented to survey adverse events associated with blood transfusion. It is an element of transfusion safety.

Haemovigilance is indispensable when it comes to safety and quality of blood transfusions. The purpose of haemovigilance programme is to identify unexpected or undesirable effects of transfusion of blood components by ensuring they are reported in a timely and reliable manner (SHOT, 2004). The haemovigilance system receives, collates and follows up reports from hospitals and general practitioners on adverse reactions and events connected with transfusion of blood components and product as well as provide feedback information to those making the reports as appropriate (Faber, 2005). The ability to produce a report of this type requires support from individuals, including doctors, nurses and laboratory staff involved in the delivery of transfusion to patients. The provision of safe transfusion therapy is a basic requirement of advanced medical care.

Despite major advances in viral and bacterial detection and the subsequent reduction in risk of transfusion-transmitted infections, there are still other significant risks associated with transfusion (NBTS, 2007). For example in UK, mis-transfusion and non-infectious hazards of transfusion account for 50% and 95% (respectively) of reported adverse reactions transfusion (UK SHOT Report, 2003). The transfusion literature clearly shows that the risks of these types of events are several orders of magnitude higher than those for viral infection such as HIV, HBV, or HCV.

For effective haemovigilance programme, National Blood Transfusion Service (2007), states that:

1. It shall be a system for reporting and evaluating suspected complications of transfusion.
2. In the events of a suspected transfusion reaction, the person attending to the recipient shall notify the responsible medical practitioner immediately.
3. The medical practitioner shall report the incident as soon as possible in writing to the designated authority and the chairperson of the hospital's Transfusion Committee.
4. In the events of severe morbidity or mortality, the report may be initially oral, and then suddenly in writing.
5. All suspected transfusion reactions shall be promptly investigated and documented.
6. It is the responsibility of the National Blood Service to maintain a haemovigilance register of all reported reactions in terms of the regulation relating to blood and blood products.
7. The service shall conform to other requirements of the national haemovigilance programme, and submit a monthly report to the National Haemovigilance Unit.

Through this initiative, National Blood Service (NBS) aims to receive and consequently analyze reports regarding transfusion-related adverse events. The data gathered from the programme will then enable NBS to

- Provide the clinical community with a reliable source of information about untoward effects of transfusion.

- Recommend corrective measures for preventing the recurrence of particular events dysfunction in the transfusion process.

Warn hospitals and blood services about adverse events that could involve individuals than a single recipients e.g. transmission of infectious diseases, problems with blood bags, solutions or blood processing etc. (WHO, 2007).

Blood Transfusion Safety

Serious adverse events can occur at every step of the progress of blood transfusion. The most dangerous ones are the result of mis-transfusion. This is the transfusion of blood to the wrong patient. The risk of mis-transfusion is many times greater than the risk of HIV or hepatitis virus transmission by blood, and mis-transfusion is the second most frequent cause of mortality and major morbidity after transfusion related acute lung injury. The single most important factor is incidents of wrong blood sample collection, collection of blood from the blood refrigerator, or at the time of administration (Michael, 2006).

A Solution to Transfusion Safety

Solution to transfusion safety includes staff training, performance standards and developments in technology. But some cannot be easily classified, such as the repeat determination of the patient's ABO group at the bedside before transfusion (Dujardin *et al.*, 2000), and physical barriers to transfusion, such as placing the unit of blood in a locked plastic bag which can only be opened with a code marked on the patient's wristband and the cross-match sample. However, none of these methods is deal in that they are impractical for routine practice and/or costly, and they have not been shown to be effective in preventing transfusion errors (Aubuchon *et al.*, 1996; Dzik *et al.*, 2003; Wenz *et al.*, 1991).

B Staff Training

The development of the role of "transfusion safety officers" sometimes called haemovigilance correspondents, 'transfusion nurses', or specialist practitioner of transfusion to promote safe and effective transfusion practice in clinical areas has helped in controlling mis-transfusion (Dzik *et al.*, 2003). Their activities include: education and training of the many staff involve in some aspect of transfusion, observational audit of all steps of all transfusion process including patient identification and bedside checking, audit of blood use and initiative to improve the use of blood (Michael, 2006).

C Performance Standard

Detailed performance standard have been defined for the safety and content of blood components ('blood safety'). However, they do not exist for 'transfusion safety' in hospitals, for example in key areas such as sample collection for compatibility testing, and bedside checking, ensures the patients will receive the right blood (Dzik *et al.*, 2003). The development of performance standards would provide as strong incentive for hospitals to monitor practice and seek resources to improve practice where necessary. Specific suggestions on performance standards for sample collection have been proposed (Dzik *et al.*, 2004), and they could be developed for other parts of the transfusion process including bedside checking before the administration of blood.

World Health Organisation has a strategy for blood safety, which includes the following:

- A well-organised, nationally coordinated blood transfusion service that can provide adequate and timely supplies of safe blood for all patients in need.
- The collection of blood only from voluntary non-remunerated blood donors from low-risk population
- The appropriate clinical use of blood, including the use of alternative to transfusion wherever possible and safe administration of blood and blood component
- Quality system covering all stages of the transfusion process (WHO, 2007).

Quality Control in Blood Group Serology

The term quality control covers that part of quality assurance which primarily concerns the control of errors in the performance of tests and verification of test result. Quality assurance has been defined by world health organisation (WHO) as the total process whereby the quality of laboratory report can be guaranteed (Cheesbrough, 2004).

The process of quality control in blood transfusion is to ensure the maximum safety of the blood donor and of the recipient of a blood transfusion. The term embraces the surveillance of the procedure involves all stages of blood transfusion; the collection of blood, serological tests preformed and the actual transfusion

of blood. According to the American Association of blood banks 1994, quality control in blood transfusion involves; organisation of hospital blood bank including serology, personal competence, equipment calibration and maintenance, method of storage of blood, and reagent control.

Errors in the misuse of blood, donation of blood, storage and testing of blood, documentation errors, and failure to carry out checking procedures, can have fatal consequences for patients. Errors can result in blood shortages, expensive reagents being wasted and a lack of confidence by patients and blood donors in blood transfusion services. It is therefore essential to ensure that quality control in blood transfusion practice is sufficiently comprehensive but not realistic. It should be affordable, implemented by those involve and monitored (Cheesbrough, 2004).

Implicit in it is the motion of proper documentation, proficiency surveillance, reviews of the standard operative procedure, which include donor selection, quality control (QC) of reagent as per laid down specifications, QC of technical operation and equipment, QC of component separation and transfusion practices. This has to be reviewed from time to time and adjusted to ensure transfusion of safe, pure and potent blood and blood products, judicious administration of which is apt to be efficacious (Dutta, 2006).

The process of providing a blood component to a patient is a complex one and problems may crop up in different points. Therefore quality assessment begins with ensuring that activities within the blood bank are efficient, safe and effective. The goal of quality monitoring should be to continuously improve service to patients (Gupte, 2000). Reagent supplies, equipment and temperature sensing devices must be monitored in the blood bank. Unsatisfactory instruments should be discarded and their final disposition should be documented. The preparation of blood component and each step in the process must be documented. Personnel must be trained and their performance evaluated. Emphasis should also be given to routine maintenance, repairs, testing performed on instruments from the time of receipt until instrument is removed from service (Gupte, 2000).

Quality control can be achieved through quality surveillance of the quality requirement of the product (blood and component) through internal quality control and external assessment. Internal quality control is done within the blood bank that includes investigative, diagnostic, banking and processing of blood. This monitoring is done separately by one senior scientist who recommends the necessary corrective measures in respect of reagents; equipment, procedure or any other deficiency observe by him in regard to functional flow, design and management that concerns the quality control. External assessment is done by an outsider agency either by comparing all the data with that of reference laboratory or by cross checking the data of one laboratory with other laboratory for the use of sample and procedure etc. (Dutta, 2006).

A Documentation

Documentation forms the sheet anchor for safe transfusion practice rather; it may be a reflection of correct laboratory performance in a blood bank. The requisition form that includes all detailed of patient is required for identification of the accompanying blood sample. A proper checking and cross checking, records of all tests, and control of compatible unit issued on a particular patient are essential. Preservation of receipt sample and donor units are the routine blood banking procedure that ensures supply of quality blood or component as pre demand prescribed by the user, depending on the necessity action deemed necessary to ensure quality control (Dutta, 2006).

A documentation system must be in place to trace significant steps in the processing of donor blood and patient sample. It must include the final disposition of units. The documentation system may be manual, computerized or a combination of both the methods. Abbreviations and symbols must be properly defined, results plus conclusions must be appropriately recorded, and ensurance of confidentiality and security of the information must be a part of documentation. It must have reports of transfusion reactions, errors, accidents, and must be legible. If a computer system is used, it must be tested to ensure that it operates as expected (Gupte, 2000).

C Standard Operating Procedures (SOPs)

SOPs must be prepared and locally applied for all transfusion related activities. In blood transfusion practice, SOPs are required for the following:

i Use of Blood, Blood Products and Blood Substitute

This is to include information which must accompany a request for blood, how to calculate the volume of blood to use, particularly when the patient is a child. Also identity checks and documentation required when collecting blood from a patient, from the blood bank and before setting up a blood transfusion at the bedside of a patient. Not forgetting procedure to follow when the patient is being transfused and what action to take should there be an adverse reaction to the blood and a system for auditing how blood is used.

ii Donation of Blood

Donation of blood is to include criteria for accepting a person as a blood donor and detail of medical screening and pre-testing procedure. There should be policy and procedure for counseling donors with regard to HIV screening, testing and maintaining the confidentiality of blood donor information. A detail of how to collect blood from donor, labelling of the donor blood, caring of the donor following donation and frequency of donation, special requirement of mobile blood donation and transportation of blood, and blood donation record should be all inclusive in donation of blood (Cheesbrough, 2004).

iii Screening of Donor Blood for Infectious Agents and Blood (Grouping)

This should encompass infectious agent for which screening is required and details of reagents, control, equipment, techniques and recording results. Procedure for typing blood includes detailed of antisera, test cells, control results and labelling of blood unit.

iv Compatibility Testing (Cross Matching) of Blood

This is a very sensitive aspect of the whole process of transfusion as safety of blood depends on accurate patient and sample identification at all stages starting from collection of blood from the patient for compatibility testing and ending with transfusion of compatible blood. It should include details of the request form and patients blood sample, procedures for compatibility testing including use of controls, interpretation and recording of test results, procedure for emergency compatibility testing and labelling compatible blood (Dacie *et al.*, 2001).

D Safety Issues

Safety issues include safe handling of blood and blood products. Disposal of contaminated and expired blood, documentation of work surfaces and laboratory software and preparation of sodium hypochlorite solutions is very important (Cheesbrough, 2004).

i Procurement of Supplies

This should include procedure for ordering essential reagents, HIV and other test kits, recording expenditures and keeping financial accounts and reliable systems for transporting essential supplies. There should also be the checking of expiry date and specifications, recording supplies upon their receipt, storage requirements of antisera, reagents and test kits (Cheesbrough, 2004).

ii Storage of Blood

A Standard Operation Procedure for the storage of blood should include temperature requirement, checking and recording the temperature of the blood bank refrigerator. There is need for location of prescreened, screened, and cross-matched blood. Procedures pertaining to the use and security of a blood bank, refrigerator should be put in place. There should be procedure for checking the appearance of blood for signs of contamination before it is issued and documentation checks and the availability of the blood bank records.

Preservation and Storage of Blood

Lewisohn in 1915 used citrate as anticoagulant. It made transfusion safer for all patients. The first anticoagulant preservative was introduced by Rous and turner in 1916. It consists of a citrate-glucose solution in which blood from rabbit was stored for two weeks, which prevented anaemia when transfused in another rabbit who suffered from blood during the First World War. The next important development occurred in 1943 during the Second World War when acidified citrate dextrose (ACD) was introduced for clinical use. Gibson *et al*, 1957 produced an improved preservation of citrate-phosphate dextrose (CPD), which was less acidic than ACD and maintain 2,3-diphosphoglycerate (2,3-DPG) level better than in ACD solution. CPD eventually replaced ACD and became commonly used preservative for storage of blood/red cells in liquid form. Shelf-life of blood stored in CPD at 2-4^{0}C was 21days.

In 1978, citrate-phosphate-dextrose with adenine (CPDA-1) preservative was developed. The addition of adenine improved the synthesis of adenosine triphosphate (ATP) in the stored blood, which prolonged the storage of blood/red cell at 2- 4^0C for 35days. In 1983, additive solution containing saline, adenine and dextrose was approved for use in red cell products. It extended the shelf-life to 42days after phlebotomy. Another low temperature storage method is to freeze the used cells at -196^0C in liquid nitrogen. The red cell are preserved in aluminum canisters since the standard plastic pack disintegrate in liquid nitrogen. The freezing, thawing and recovery of cells ready for transfusion require special technique and thus blood may be stored for 10yrs. This frozen blood of course is expensive but has unmatched advantage over blood stored at 7^0C (Gupte, 2000).

Additive solution for preservation of blood is found useful only in case of red cells. Hence plasma and platelet products are separated and prepared first. The additive solution is then added to the red cells; the solution was SAG (saline, adenine, glucose and mannitol). Another solution with more amount of mannitol is used recently under the formula known as Adols or Asl. Other available additive solution product is Nutricel or AS^3 (Aylward, 1990).

Conclusion

Blood banks is a compact unit where blood accepted from donors, are processed, stored and finally issued to needy patients on recommendation of doctors. It is a unit responsible for all activities that lead to the preparation and transfusion of suitable blood products. Donor recruitment, blood donation, processing and storage are the areas covered under it. The location of blood bank should be situated in hospital premises and should run independently both technically and administratively. Blood bank has to be located in a central place easily accessible preferably in a ground floor to all department and existing services of the hospital. The reception room should be quite spacious to accommodate a number of donors and patients, with proper sitting arrangement. This room must possess comfortable beds for donors, sterile equipment for bleeding donors, a refrigerator and resuscitation equipment. In the donors' rest room, the donors are served with light refreshment with a close observation of the donor after blood donation. Blood bank is vital in every hospital because of emergencies to save lives.

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