Blood Bank and Transfusion Services Part 2

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Techniques of Blood Transfusion

- Large amount of pre-transfusion activities are carried out to make blood and blood product safe
- These are:
  - Selection of suitable donor
  - Produce components
  - Use appropriate tests, and
  - store them under controlled conditions
- Final stage of transfusion must be done carefully so that transfusion will be as safe and effective as possible

Techniques of Blood Transfusion

- Transfusion-related fatalities are estimated to occur once in 100,000 patients
- Most common cause of fatality is haemolytic transfusion reaction
  - This is due to ABO incompatibility
- This is usually the result of "management" error
  - Most of these management errors occur outside the blood bank

Techniques of Blood Transfusion

- These errors are as under:
  - Failure to properly identify the recipient when the blood sample is collected for compatibility testing
  - Incorrect labelling of the properly collected sample
  - Improper labelling of the tubes when testing is carried out in the laboratory
  - Use of incorrect sample in the laboratory

Techniques of Blood Transfusion

- **Obtaining Consent for Transfusion**
  - On deciding that transfusion is necessary, the procedure should be explained to the patient
  - This is required
    - To allay the patient's apprehension
    - To obtain patient's consent
  - The elements of consent are standard and include:
    - Nature, severity and probability of risks and the general time frame in which they can occur
    - Documentation of reason for transfusion

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Techniques of Blood Transfusion

  - Alternatives to transfusion as is required now
- There is a great variation in how consent is obtained
  - Physician may discuss with the patient
  - Nurse may explain to the patient
  - Using a printed consent form for patient's signature
  - Incorporation of information in general consent material
- Physicians are expected to ensure that
  - Patients understand the risks of transfusion and
  - Any alternatives to homologous donor blood that might be available

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Techniques of Blood Transfusion

- **Obtaining blood sample for compatibility testing**
  - Most common error for incompatible transfusion is mislabelling the blood sample to be used for testing
  - Mislabelled blood sample are responsible for many transfusion being administered to the wrong patient
  - Wristband of patients are commonly used for patient identification
  - Errors in the availability and accuracy of wristbands are common

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Techniques of Blood Transfusion

- Hospitals should have a specific written procedure for obtaining blood samples
- Individuals collecting blood samples should be familiar with the procedure and follow them
- This procedure typically involves:
  - Checking the identifying information on patient's wrist band against the blood request form
  - Labels should be applied to the blood specimen at the patient's bedside
  - Label should indicate patient's full name and hospital number
  - The label should also identify the phlebotomist

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Techniques of Blood Transfusion

- The blood sample should be checked when it arrives in the blood bank
  - This is to ensure that all required information is completed
- It is not acceptable to change or "correct" information on a specimen label
- In case of any doubt, a fresh sample to be obtained
- Blood sample should not be obtained from an arm being used for the infusion of intravenous fluids
  - This may alter the blood specimen and invalidate cross match

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Techniques of Blood Transfusion

- Blood administration sets and filters
  - Blood and blood products are administered through a filter
    - This is because fibrin clots and other particulate matter may be present
  - It was earlier believed that ARDS develop following massive transfusion
    - Reason ascribed was that lodging of micro emboli in the pulmonary micro circulation
  - With better understanding of ARDS, it is now clear that the situation is more complex and
    - Micro emboli are not the primary cause of ARDS

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Techniques of Blood Transfusion

- Currently filters are used only for transfusion of blood salvaged from cardiac surgery
- Filtration process now is carried out in blood bank
  - This filtration is used for leukodepletion
  - The leucocyte depletion filters remove more than 99% of the leukocytes from the blood component
- The leukocyte removal prevents accumulation of cytokines in stored blood
- The cytokines are responsible for febrile non-haemolytic transfusion reaction

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Techniques of Blood Transfusion

- Venous access and Venipuncture
  - Blood components are administered intravenously,
    - Usually by venepuncture of a peripheral vein
  - ICU patients may need central venous catheter

—Peripheral vein to be so selected that it accommodates at least a 19 gauge needle

—Vein in the anti-cubital fossa is usually suitable

—This site is suitable if only one or two units are to be transfused as this restrict flexing of the elbow

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Techniques of Blood Transfusion

- Small lumen needle of 23 gauge may be used for red cell administration to small paediatric patients
- In adult, if the size of the patient is small and veins are thin small bore needle may be used
- Transfusion of red cell under pressure through these small bore needles may cause haemolysis
- Flow rate may be increased by diluting the red cells with saline

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Techniques of Blood Transfusion

- Infusion solutions
  - For storage of red cells additive solutions are used
  - This results in appropriate haematocrit and viscosity allowing rapid flow rates
  - Therefore, there is no requirement for further addition of any fluid to improve the flow characteristics
  - Sometimes this need arise in case of exchange transfusion and other special transfusion situations

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Techniques of Blood Transfusion

- Usually, normal saline is the solution recommended in the transfusion of blood components containing red cells, platelets, or leucocytes
- There are some other solutions that can be used
- These are: 5% normal serum albumin, plasma protein fraction or ABO compatible plasma
- There is no special advantage and they cost more
- Dextrose in water 5% solution is not satisfactory as they cause RBC swelling

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Techniques of Blood Transfusion

- Identification of patient and blood component
  - It is important to see that correct patient gets the correct blood component
  - The process begins with the release of the component from the blood bank
  - Transportation of the blood component is done either by mechanical transport or by hand carriage

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Techniques of Blood Transfusion

- If mechanical transportation is used, the technologist releasing the blood component must check
  - The request form to determine the component ordered
  - The correct unit of blood component is released as per the request
  - Reviewing the name
  - Identification no.
  - ABO and Rh type of recipient and donor unit
  - The result of compatibility test and appearance of the unit

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Techniques of Blood Transfusion

- If the component is to be transported by personnel same procedure is followed
- In addition the individual usually reviews
  - Identity of the unit and the patient with the blood bank staff member who releases the blood unit
- Blood bank staff also records the name of the person to whom the component is being released
- Each hospital should have specific policies defining the personnel authorized to receive blood component and transport them to the patient care unit

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Techniques of Blood Transfusion

- Usually blood is administered by a nurse
- In the OT, a technician or a perfusionist may administer
- Anyone administering blood should be trained in the procedure
- Before beginning the transfusion, it is extremely important to correctly identify the patient and blood component
- This is the last opportunity to identify any error
- Failure of this step results in two-thirds of transfusion errors
- Most common cause of fatal transfusion reaction is administering units to wrong patient
  - It is ideal for two persons to carry the steps involved independently in cross-checking the information

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Techniques of Blood Transfusion

- Starting the transfusion
  - Accumulate all supplies and equipment before initiating transfusion
  - Ask the patient if he/she has any question
  - Build an atmosphere of rapport and assurance with the patient
  - Check medical record to determine that the transfusion was ordered, and
    - Correct component being administered

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Techniques of Blood Transfusion

- Obtain and record baseline vitals
- During storage in the blood bank, the platelet concentrate undergoes continuous gentle agitation
- If platelet is left undisturbed for prolonged periods, the pH may rise and damage may occur
- Components should not be exposed to hot or cold temperatures
- After receiving the unit, transfusion should start immediately
- Blood components should be stored in a regulated blood bank refrigerator until immediately before transfusion

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Techniques of Blood Transfusion

- However, platelets and thawed cryoprecipitate should be at room temperature
- There is an interval between removal of red cells from the refrigerator and initiation of transfusion
  - Policies and procedures should be laid down to cover this period
- It is not possible to monitor the temperature of the blood while it is outside the blood bank
  - Blood bank should lay down a time limit within which the blood may be suitable to use
- The time limit within which the Red cells can remain outside the refrigerator should be laid down by the hospital
  - Usually it is between 30 and 60 minutes

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Techniques of Blood Transfusion

- Rate and Duration of Transfusion
  - This depends on the clinical condition of the patient and the component being transfused
  - If the patient is not in congestive failure or in danger of fluid overload, then one unit of red cell can be transfused in 1-2 hours
  - First 25 to 30 ml should be given slowly and patient monitored closely to minimize severity of transfusion reaction
    - If OK rate can be increased
  - Transfusion should be completed in 4 hours to avoid chances of bacterial proliferation at room temperature

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Techniques of Blood Transfusion

- Use of Infusion Pumps
  - These are valuable for transfusing neonates or small children
  - Syringe infusion pumps are suitable where screw mechanism is used to advance the plunger
    - In these cases the flow rate must be less than 40ml/hour
  - These devices are also valuable for adults where precise volume control is necessary
  - Nursing staff should take into consideration the lumen size of the needle when using infusion pumps
    - Too small bore needle may cause haemolysis

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Techniques of Blood Transfusion

- Nursing Care of Patients
  - Nurse should alley apprehension of patients, if there is any by answering questions and establishing rapport
    - Baseline vitals to be recorded
  - Sufficient time should elapse after premedication, if any, to take effect before transfusion
  - All supplies and equipment should be accumulated at the bed side before starting transfusion
  - For first 15 minutes, rate 2-4 ml/minute
    - Nurse should observe the patient closely at least for first 5 minutes and return after 15 minutes
  - If uneventful, flow rate can be increased to what has been ordered by the physician

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Techniques of Blood Transfusion

- Transfusion to Neonates/small children
  - All routine procedure to be carried out
  - These patients need special attention to the methods of administering the transfusion
    - Needles or catheters of size from 22 to 27 gauge is used
      - Haemolysis can occur when red cells with high haematocrit or longer storage time are forced through small-bore needle
    - Older the red cells, the more important these factors become
  - Paediatric type sets to be used to avoid filling the "dead space" of the tubes in comparison to small volume that is transfused
  - Microaggregate in stored blood may pass through patent foramen ovale or intra-pulmonary shunting into systemic circulation
    - Usually fresher blood or leucodepleted (thus avoiding microaggregates) blood is used

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Techniques of Blood Transfusion

- Transfusion of platelets or plasma
  - The general procedures for transfusion to be followed
  - Transfusion reaction can occur from antibodies contained in platelets and plasma
  - Platelets and plasma require special storage conditions
    - As these conditions can only be provided by the blood bank, they should be transfused promptly after receiving
  - Blood filter should be used as cellular aggregates and fibrin strands may be present
  - If the administration set is large flushing with saline to be done to push remaining platelets or serum from the tube

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Complications of Blood Transfusion

- Acute reactions are defined as adverse events occurring during or within 4-6 hours of transfusion
- They can be placed in following categories:
  - acute haemolysis (AHTR)
  - allergic
  - anaphylactic
  - transfusion-related acute lung injury (TRALI)

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Complications of Blood Transfusion

- febrile non-haemolytic reactions (FNHTR)
- bacterial sepsis
- hypotension
- transfusion-associated circulatory overload (TACO)
- acute pain reaction
- metabolic complications (hyperkalaemia, hypokalaemia, hypocalcaemia, hypothermia).

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Complications of Transfusion

- Long term mortality of patients following transfusion:
  - 31% in first year
  - 14% in second year
  - 10% per year in years 3-5
- Shorter survival was associated with:
  - increasing patients' age, increasing number of RBC units transfused, receipt of plasma or platelet
  - Most complications are due to underlying disease
    - But, complications of transfusion are serious and often life threatening

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Complications of Transfusion

- Complication of transfusion are of two types:
  - Immunologic
  - Non-immunologic
- Immunologic complications in various forms are usually considered as transfusion reaction
  - There is also immunomodulation effect of transfusion of cellular products
- Non-immunologic complications are usually caused by:
  - The physical effects of blood components or
  - The transmission of disease

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Complications of Transfusion

- Many complications are caused by the leucocytes contained in the product
- Almost 20% transfusion result in some kind of adverse effect
  - Of these, 0.5% are serious
- The short term fatality rate is about 1-1.2 per 100000 transfusions (in USA)
  - Common reactions are:
    - haemolytic reactions, transfusion related acute lung injury (TRALI), circulatory overload, transfusion-induced graft- versus host disease (GVHD) and metabolic alterations

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Complications of Transfusion

- Haemolytic Transfusion Reaction
  - Causes could be many:
    - Red cell antibody in recipient
    - Red cell antibody in transfused plasma
    - Large volume of aged red cell
    - Additions of drugs/ intravenous solutions to donor unit
    - Bacterial contamination of red cell unit
    - Red cell enzme deficiency in the donor
    - Excessive warming of donor unit
    - Excessive freezing of donor unit
    - Trauma to red cells from extracorporeal instruments

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Complications of Transfusion

- ABO-incompatible haemolytic transfusion reactions
  - These are very dangerous
  - The patient has preformed ABO antibodies
  - These are often IgM and bind complement
  - This causes activation of the complement system
    - Systemic manifestations are also associated
  - This ultimately leads to red cell lysis.
  - Occurrence of symptoms relates to the volume of incompatible red cells received
    - 64% reactions occur after >50 mL and 16% from <50 mL have been received

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Complications of Transfusion

- Delayed Haemolytic Transfusion Reaction
  - Occurs when no red cell antibody was found during compatibility testing
  - Accelerated destruction of transfused cells occur after an interval
    - During this interval antibody to the transfused red cells develop
  - The interval may range from 24 hours to one week
  - Haemolysis is detected by drop in haemoglobin level
  - It can also be recognised by finding a red cell antibody in a subsequent blood specimen

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Complications of Transfusion

- Haemolysis due to passenger lymphocyte syndrome
  - In organ transplant, some immunosuppressive regimens are B-cell sparing
  - This allows these passenger lymphocytes to remain viable and functional
  - In blood group incompatibility, these donor derived passenger lymphocytes may produce antibodies against recipient's red cell
  - This produces haemolysis
  - Passenger lymphocyte-related haemolysis has occurred following transplantation of liver, lung, heart, kidney, pancreas and intestines
  - The haemolysis occurs usually within 2 weeks

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Complications of Transfusion

- Non-immunologic haemolysis mimicking a transfusion reaction
  - Haemolysed blood if transfused may produce signs and symptoms of haemolysis
  - This may appear to be an immunologic haemolytic transfusion
    - In fact, it is transfusion of free haemoglobin
  - Percutaneous mechanical thrombectomy may appear to be immunologic transfusion reaction

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Complications of Transfusion

- Febrile non-haemolytic transfusion reaction
  - Occurs in about 0.5-1.0% of transfusion
  - It is believed to be due to leucocyte antibodies present in the patient
    - This antibody reacts with leucocyte present in transfused component
  - Severity depends on number of leucocytes in the blood component
  - Some patients who do not have leucocyte antibody may exhibit reaction

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Complications of Transfusion

- Allergic reaction
  - This is more frequent
  - Occurs in about 1-2% transfusions
  - Range from annoying hives to severe respiratory or anaphylactic
  - Almost 30% donors below 30 have allergic disorders
    - IgE antibodies are probably informed
  - Cytokines produced in stored blood and vasoactive substances play a key role in transfusion reaction

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Complications of Transfusion

- Transfusion Related Acute Lung Injury (ALI)
  - It is more prevalent than believed previously
  - Post transfusion ALI is associated with :
    - Female donor plasma,
    - Multiple pregnancies of donors of plasma,
    - Presence of antigranulucyte or HLA class II antibody in donor plasma
  - A very severe type of transfusion reaction is the acute, sometimes fatal, pulmonary reaction that has been termed TRALI

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Complications of Transfusion

- Anaphylactic Reactions
  - This may be due to antibodies against IgA, component C4, haptoglobin, or other unknown plasma protein
  - Patients who are IgA deficient may have anti-IgA antibodies
    - If blood component containing IgA is transfused to these patients, they may experience an anaphylactic reaction
  - Occurs 1 in 20000 to 1 in 47000 transfusions
  - IgA deficiency ranges from 1 in 223 to 1 in 3000 blood donors
  - These reactions are dramatic and rapidly fatal

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Complications of Transfusion

- Hypotensive Reactions
  - Occasionally, severe hypotensive reactions have been reported
  - Patients on ACE inhibitor drugs receiving transfusion through a bedside leucodepletion filter are prone
  - These reactions are the result of bradykinin that is not inactivated in patients taking ACE II inhibitors

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Complications of Transfusion

- Reaction to Platelet Transfusion
  - Patients with platelet or HLA antibodies may have reactions
  - The probable cause is presence of leucocyte
  - The reactions usually involve chills and fever
  - Platelets may also be trapped in pulmonary capillaries
    - This may cause dyspnoea and pulmonary oedema
  - Studies have suggested that this is the result of cytokines produced by leucocytes
  - Removal of leucocytes soon after collection of blood prevents these reactions

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