

MD TRANSFUSION MEDICINE AND IMMUNO HAEMATOLOGY

History of Transfusion Medicine

Identify and relate the important features of the history of transfusion medicine
Outline the scientific benchmarks in the evolution of transfusion medicine
Explain how specific innovations affected transfusion medicine practice
Describe recent trends in the practice of transfusion medicine

Scientific Basis of Transfusion

Describe the biochemical properties and characteristics of the major surface antigens of the formed elements of the blood

List the clinically significant antigen systems and associated phenotypes

Compare the expression of these antigen systems on red cells and other cells in blood

Describe the biochemical properties of the ABO antigens

Describe the biochemical properties of the Rh and MNS blood group systems

Genetics of the major surface antigens of the formed elements of the blood

Describe the principles of antigen inheritance

Identify the genotypes that produce the common phenotypes in the ABO and Rh systems

Order and phenotypes of the ABO and Rh blood groups by frequency of occurrence in the major ethnic groups.

The role of the HLA (major histocompatibility complex (MHC) system in transfusion, transplantation and associated diseases

Describe the nomenclature used for the HLA (MHC) system

Describe the inheritance of HLA antigens

Compare the biochemical properties of Class I and II antigens

Describe the distribution of the HLA antigens on blood cells and other tissues

Explain the role of MHC in cellular immunology

Describe the microlymphocytotoxicity assay, comparing its use for HLA typing and crossmatching.

Describe the principles of the mixed lymphocyte culture test

Identify clinical situations in which the mixed lymphocyte test is used for donor selection

Identify significant HLA disease associations

Analyze the clinical and pathological consequence of antibodies to red cells

Distinguish the naturally occurring antibodies from those requiring prior immunization

List the blood group systems in which antibodies are naturally occurring and the most important ones in which unexpected (irregular) antibodies occur

Compare transfusion and pregnancy as immunizing events

Describe the techniques for detection of antibodies / complements on red cell membrane

Interpret the results of tests for detection of red cell antibodies

Outline the mechanisms of red cell destruction

Describe the importance of complement activation and antibody mediated red cell destruction

Relate the kinetics and function of the cellular elements of blood to normal and disease states

Describe the process of cell production of red cells, neutrophils, lymphocytes and platelets

State the lifespan of blood cells in normal and disease states

Describe neutrophil functions in defense against bacterial infection

Describe the role of the platelet in hemostasis

Describe the function of lymphocyte subpopulations in normal and disease states

Outline the pathophysiology and clinical features of disorders caused by abnormalities of cell function or number.

Relate the structure and function of haemoglobin to normal and disease states

Describe the role of haemoglobin in oxygen transport

Draw the haemoglobin molecule indicating the oxygen-binding sites

Describe how abnormalities in haemoglobin may affect the ability to transport oxygen

Outline the Steps I haemoglobin degradation

State the amount of iron normally present in the blood and narrow storage compartment.

Apply the principles of basic mechanism of blood coagulation to the diagnosis and treatment of coagulation disorder.

Describe the interaction of soluble coagulation factors with platelets

List the steps in the fibrinolytic pathway

Identify the abnormalities of coagulation in common hemostatic disorders

Describe the role of fibrinolysis in normal and abnormal hemostasis

Describe the interactions among the coagulation, complement, kallikrein, and immunologic systems.

Describe the principles of the common screening tests for abnormalities in haemostasis.

Interpret the results of coagulation tests in specific clinical situations.

Integrate clinical information with result of coagulations tests to establish a diagnosis and treatment plan.

Relate the principles of the hemodynamics of circulation to the diagnosis and treatment of hypervolemia and hypovolemia.

State the normal values for blood volume

Identify the physiologic mechanisms for control of blood volume.

Describe the compensatory mechanism for abnormalities in blood volume

Describe the symptoms and signs associated with abnormalities in blood volume.

Integrate the clinical and laboratory data to establish the diagnosis of hypervolemia and hypovolemia

Management of blood donation and preparation of blood components

Determine the acceptability of individuals for blood donation through appropriate consultations with donor personnel.

Identify the donor's risks in blood donation.

Identify potential risks to the recipient.

Construct a plan to care for blood donors

Delineate the complications of blood donation.

Describe the presentation and management of complications of blood donation

Analyze significant issues in donor recruitment

Explain the concepts of community responsibility and individual responsibility

Compare paid and volunteer blood donation systems

Define directed donation and autologous donations.

Describe the impact of these types of donation on the safety and adequacy of the blood supply

Outline the procedures for donor blood processing

Name the tests required for donor blood processing.

Describe the potential patient complications if errors occur in donor blood processing.

Evaluate the effectiveness of pretransfusion hepatitis, syphilis, and HIV testing.

Describe the preparation and composition of blood components

Outline the basic steps in component production.

List the functional composition of each component

Describe the preparation and production of blood derivatives

Distinguish between a blood component and a blood derivative

List the blood derivatives that are prepared commercially.

Describe the composition of each blood derivative

Describe the changes in blood component

State the expiration period for each component

Describe the changes in each component with storage

Identify adverse effects of transfusion that may result from storage-induced change in blood components.

Compare the potential risks and benefits of transfusing blood products stored for varying lengths of time

Pretransfusion testing

Explain the basic procedures used for blood compatibility testing:

Define the basic terms associated with tests for blood compatibility

Explain the principles of red cell compatibility

Describe the methods for determining compatibility of donor blood with the recipient.

Explain what 'Compatibility crossmatch' means

Distinguish testing procedures for red cell and red cell free components.

Describe and explain the criteria for selection of an appropriate donor unit.

Distinguish between emergency and elective selection of blood

Apply immunologic principles of blood cell compatibility to clinical situations

Identify the clinical situations associated with formation of antibodies to blood cell antigens.

Correlate the results of laboratory tests within vivo reactions.

Transfusion of blood components

General aspects of transfusion

Describe the major indications for the following blood components and derivatives.

Whole blood

Red cells (including additive solutions)

White cell poor red cell products (such as washed red cells, previously frozen deglycerolized red cells, and filtered red cells).

Platelets (concentrates or apheresis product)

Granulocytes (concentrates or apheresis product)

Single-donor plasma (eg. Fresh-frozen plasma or plasma frozen after 24 hours)

Cryoprecipitate

Coagulation factor concentrates (eg. Factor VIII, prothrombin complex, or anti-inhibitor coagulant complex)

Colloid solutions (albumin and plasma protein fraction)

Autologous blood (pre-surgical deposit or intraoperative and traumatic salvage)

Vaccines (eg. Hepatitis B vaccine)

Construct an appropriate plan for administering blood products (19, 1-19, 12) that considers dosage, infusion equipment, and rate of administration. B. Cardiopulmonary bypass

Diagnose and develop a plan for treatment of symptomatic coagulation abnormalities develop in following cardiopulmonary bypass (CPB).

List the laboratory tests that should be ordered to evaluate a patient bleeding after CPB.

List the laboratory tests that should be ordered to evaluate a patient bleeding after CPB.

Synthesize the clinical and laboratory information to establish the cause of bleeding.

Select the proper blood component (or other medication) to treat the bleeding diathesis.

Emergency medicine (massive transfusion haemorrhagic shock, burns)

Construct the appropriate orders for compatibility testing in massive transfusion.

Define massive transfusion.

Identify the correct use of 'type-specific' blood

Identify the correct use of O-negative or O-positive blood in patients with unknown ABO type.

Explain the rationale for the use of various components in massive transfusion.

Describe the coagulation and metabolic abnormalities

Order coagulation and metabolic abnormalities in the terms of clinical importance.

Define the indications for platelet transfusion.

Compare the indications for whole-blood versus packed cells.

Define the indications for fresh-frozen plasma.

Evaluate the risks and benefits of blood salvage techniques during massive transfusion.

Describe fluid losses associated with burns.

Describe operative and non-operative mechanisms of fluid and protein loss in burn patients.

General surgical support

Construct appropriate preoperative orders for blood.

Recall the factor used to evaluate haemostatic safety preoperatively

Identify appropriate orders for blood and blood components for elective surgical procedure, including the use of type and screen

Describe the use of the maximum surgical blood order schedule in preparing preoperative blood orders.

Evaluate preoperative transfusion needs.

Describe the methods of predicting estimated blood loss

Describe the treatment for hypovolemia

Correlate for clinical symptoms and measurements of blood loss to determine if transfusion is needed.

Recognize the cause of blood wastage.

Define the time limits for nonrefrigerated blood

Define the desirable cross match: transfusion ratio.

Haematology and Oncology

Outline the diagnosis and management of hemostatic defects including thrombocytopenia.

Describe the clinical features of coagulopathies.

Describe the use of blood components and derivatives in the treatment of coagulopathies and thrombocytopenia

Describe the mechanism of action of heparin and coumadin anticoagulants.

Identify the special management problems present in patients receiving anticoagulants.

Plan appropriate blood support for patient with neoplastic disease.

Identify the special hematologic problems in patients with specific forms of neoplasia.

Describe the appropriate use of blood components in the treatment of neoplastic disease

Choose the appropriate blood support in the treatment of anemia.

Identify the special transfusion problems in patients with chronic hypoproliferative anemia.

Identify the special transfusion problems in patients with haemolytic anaemia.

Identify the clinical indications and contraindications for red cell transfusion.

Outline a plan for the diagnosis and transfusion support of thrombocytopenias caused by accelerated platelet destruction.

Distinguish between different types of accelerated platelet destruction

Plan blood support for bone marrow transplantation.

List the blood products used to support bone marrow transplant patients

Illustrate the use of blood products in the pretransplant and post transplant periods in patients with leukaemia and aplastic anaemia.

Neonatology and paediatrics

Describe the pathophysiology of haemolytic disease of the new born (HDN)

Diagram Rh and ABO incompatibility.

Describe the clinical effects of haemolytic disease in the foetus and new born.

Outline the diagnosis and management of HDN

Describe the methods of prenatal diagnosis (e.g. maternal history, maternal antibody titre, maternal and paternal phenotypes, and amniocentesis).

Define the indications, including the rationale, for each form of therapy for HDN (early delivery, plasmapheresis of mother, intrauterine transfusion, phototherapy and exchange transfusion).

Identify two common antibodies that cause HDN that require exchange transfusion.

Describe the selection of blood for exchange transfusion

Describe the kinetics of exchange

List the possible complications of exchange transfusion

Describe the role of Rh immunoprophylaxis (antepartum and postpartum) in the prevention of HDN

Define Rh immunoprophylaxis

Identify the indications for its use, including dosage, timing and route of administration.

Compare compatibility testing for neonatal and paediatric/ adults transfusion.

Identify the appropriate blood samples for neonatal testing

Describe the appropriate compatibility tests for the neonate.

Identify the appropriate blood types (ABO, Rh etc) for component separation.

Compare the procedure used to select blood for neonate and adult patients.

Distinguish the posttransfusion risk that may be specific in the neonatal patient.

Identify situations in which the neonate is at risk for graft- versus host disease(GVHD)

Identify situations in which the neonate is at risk for postransfusion cytomegalovirus (CMV) infection.

Describe the pathophysiology of neonatal alloimmune thrombocytopenia and neutropenia.

Formulate the treatment for neonatal alloimmune thrombocytopenia and neutropenia.

Choose the appropriate component therapy.

Predict the response to therapy.

Nephrology

Illustrate the use and limitations of blood component therapy in renal disease.

Describe the use of blood components in end-stage renal disease.

Describe the use of blood components in renal transplantation.

Adverse effects of blood transfusion

Develop a plan for dealing with adverse immunologic effects of blood transfusion.

Describe intravascular “immediate” haemolytic transfusion reaction (i.e, their etiology, pathogenesis, pathologic sequelae and clinical outcome).

Describe delayed anamnestic transfusion reactions (i.e, their etiology, pathogenesis, and clinical significance).

Compare clinical syndromes occurring with the intravascular and extravascular destruction of red cells.

Describe the steps to prevent haemolytic transfusion reactions.

Outline the steps to be taken by physicians, floor nurse, and laboratory staff in response to suspected haemolytic transfusion reactions.

List the laboratory tests done for suspected haemolytic reactions.

Describe the test result that would be expected in immediate and delayed haemolytic reactions.

Distinguish immunologic from non immunologic causes of haemolysis

Describe febrile reactions.

Distinguish the cause of febrile reactions considering clinical and laboratory information.

Outline the steps to prevent and treat febrile reactions

Describe allergic and anaphylactic transfusion reaction.

Outline the steps to prevent and treat allergic and anaphylactic transfusion reaction.

Describe the clinical significance of immunization to platelet and white cell antigens.

Outline the steps to prevent alloimmunization to platelet and white cell antigens.

Formulate a scheme to manage clinical problems resulting from immunization to platelet and white cell antigens.

Develop a plan to prevent or manage the adverse metabolic effect of transfusion.

Describe the pathogenesis of adverse metabolic effect of transfusion(e.g, acidosis, hypocalcemia, hyperkalemia, hypothermia)

Recognize the clinical steps and symptoms associated each of these.

Outline a plan to prevent or manage the adverse metabolic effects of transfusion.

Analyze the adverse pulmonary complications of transfusion

Describe current knowledge about the role of micro aggregates.

Compare the roles of hypervolemia and low oncotic pressure in producing pulmonary complications.

Describe the role of white cell antibodies in producing noncardiac pulmonary oedema.

Respond to clinical situations in which transfusion- induced iron overload occurs.

Outline the steps to prevent iron over load

Describe the treatment of iron over load

Develop a plan for the diagnosis and treatment of infectious complications that can result from transfusion.

List the infectious complications that can result from transfusion (bacterial, hepatitis B, A, non-A, non-B, HIV, CMV, malaria).

Describe the cause and clinical presentation of each complication.
Outline a plan to prevent these adverse sequelae from occurring.
Describe the treatment of each identified complication.
Describe what the physician, nurse, transfusion service, and blood centre staff should do when a case occurs.
Develop a plan to prevent or manage post transfusion GVHD
Describe the cause of transfusion induced GVHD
List conditions that make transfusion recipients susceptible to GVHD.
Identify transfusion recipients who are at risk for post transfusion GVHD.
Describe the clinical course of post transfusion GVHD.
Describe the methods to manage the disease.

Autoimmunity

Characterize haemolytic anaemia
Differentiate between haemolytic and non haemolytic anemia.
Differentiate between immune and nonimmune haemolytic anemia.
Examine autoimmune haemolytic anaemia according to immunologic and clinical criteria.
Propose a plan to diagnose and treat warm reactive autoimmune haemolytic anaemia (AIHA).
Describe the pathogenesis of warm reactive AIHA
Delineate the clinical and laboratory features of warm- reactive AIHA
Describe the appropriate therapy for patients with warm- reactive AIHA
Identify factors to be considered when transfusion therapy is necessary.
Describe the appropriate treatment of or response to cold-reactive autoimmune haemolytic anaemia (AIHA).
Describe the pathogenesis of cold-reactive AIHA
Outline the clinical and laboratory features of cold-reactive AIHA
Describe the process of recognizing and diagnosing cold-reactive AIHA
Identify the different syndromes produced by cold-reactive AIHA
Identify and distinguish between different types of cold-reactive AIHA

Present a scheme for the diagnosis and treatment of drug induced immune haemolytic anaemia.
Describe the differential diagnosis of drug- induced immune haemolytic anaemia.
Identify and distinguish between different mechanisms of drug- induced immune injury.
Describe the appropriate treatment for patients with drug- induced haemolytic anaemia.

Differentiate between immune and non immune thrombocytopenia.
Outline the pathophysiology and clinical features of idiopathic thrombocytopenic purpura (TTP, also known as autoimmune thrombocytopenic purpura, ATP).
Distinguish drug-induced thrombocytopenia from ITP
Describe the appropriate management of ITP, including the role of transfusion therapy.
Construct a plan to diagnose and treat neutropenia.

Differentiate between immune and nonimmune neutropenia
Outline the clinical and laboratory features of immune neutropenia.
Describe the role of drugs in the induction of immune and nonimmune neutropenias.
Describe the appropriate management in the care of patients with neutropenia.

Transfusion

Explain the role of transplantation in patients with end-stage organ failure
List the important developments in organ transplantation
Identify the organs and issues currently being transplanted.
Contrast the factors involved in living organ versus tissue transplantation.
Identify the problems limiting transplantation.

Explain the role of antigen matching and or compatibility in selecting organs or tissues for transplantation.
List organs and tissues for which ABO compatibility is considered essential.
Describe the role of the major histocompatibility complex (HLA) in graft survival.
Describe the role of minor histocompatibility antigens in grafts survival
Distinguish between appropriate and inappropriate transfusion practices in patients undergoing transplantation.
Contrast the effect of pretransplant transfusion on graft survival in renal and bone marrow transplantation.
Evaluate the proposed immunologic mechanisms for the effect of pretransplant transfusion on graft survival in renal and bone marrow transplantation.
Identify the adverse effects associated with transfusion of immunocompromised recipients.
Describe the appropriate transfusion support for blood group incompatible bone marrow transplantation.

Therapeutic apheresis and phlebotomy

Illustrate the basic principles of therapeutic apheresis and phlebotomy
Define the terminology associated with apheresis and phlebotomy procedures (eg, therapeutic apheresis, plasma exchange, phlebotomy and plateletpheresis)
Describe the mechanisms of each of these procedures.
State the rationale for using each procedure

Describe the disorders for which phlebotomy and plasma exchange are indicated.
List the disorders for which phlebotomy and plasma exchange are considered.
Distinguish appropriate from inappropriate uses of phlebotomy and plasma exchange therapeutic procedures.

Blood Substitutes

Evaluate the volume expanders available for clinical use:

List the volume expanders available for clinical use (crystalloids, natural colloids, synthetic colloids)

Describe the biochemical and physiologic characteristic of volume expanders.

Describe the clinical presentation of the adverse effects associated with volume expanders.

Evaluate the usefulness of synthetic oxygen carrying compounds under investigation

List the synthetic oxygen carrying compounds under investigation (perfluorocarbons, and haemoglobin solutions)

Describe the results of clinical evaluations of synthetic oxygen-carrying compounds.

Medico-legal consideration

Demonstrate the principles of forensic serologic testing

Describe the resolving power of different genetic systems in paternity or other forensic testing.

Distinguish exclusion from nonexclusion in paternity testing.

Explain the limits of paternity testing.

Describe the management of transfusion therapy in individuals with religious objections to transfusion.

Examine religious objections to transfusion

Identify the religious groups which interdict transfusion.

Identify those situations in which intraoperative blood salvage would be acceptable.

Identify the legal avenues for obtaining permission to administer transfusions that are medically indicated but religiously interdicted.

Examine the ethics of seeking legal avenues for obtaining permission to administer transfusions that are medically indicated but religiously interdicted.

Explain the ethical and legal considerations pertaining to donation of bone marrow by unrelated donors and recipient.

Explain the role of informed consent

Describe the procedure for obtaining informed consent.

Explain the role and importance of confidentiality.

Describe the procedures to assure confidentiality.

Organisation and function of regional blood service and hospital transfusion service

Describe the interactions between regional blood centres and hospital based blood services.

Describe the organization and function of blood centres, including issues of quality assurance donor confidentiality and obligations to donors.

Describe the organization and function of hospital transfusion services, including issues of appropriateness of transfusion and informed consent.

Compare the function of regional and hospital blood service.