**Specialist Portfolio V4 Questions and Guidance**

The following document contains set questions for the completion of the IBMS specialist portfolio. Please complete them in adequate detail, read through the standards in the portfolio to ensure you have covered the required standards for knowledge.

Several sections require IQC and EQA information. If you complete this in detail in a previous section, you can cross reference throughout your portfolio for example it will be much the same for all of section 7.1. This also helps your portfolio read like a single document.

The purpose of the specialist is to finish having learnt more than you started. Keep this in mind when answering questions, in that you should need to do a lot of additional reading to build on your current knowledge and practical experience, to answer the questions in the required depth.

**7.1 Primary Investigation of Blood and its Components**

**7.1a Cell counting and haemoglobin concentration measurement**

1. Describe in detail the principles and practice of automated cell counting/concentration methods for:
   * Leucocytes
   * Erythrocytes
   * Platelets
   * Reticulocytes
   * Nucleated RBCs
   * RBC parameters
   * Haemoglobin
2. With the aid of diagrams discuss how the DxH900 differentiates WBC
3. When would a calibration be indicated and how would this be performed on the DxH?
4. What are the normal reference ranges for parameters measured by the DxH900
5. Discuss the significance of out of range results, include when and how further testing would be completed.
6. How would you deal with out of range QC results? Discuss a number of possible causes and corrective action in each instance
7. Describe the effects of pre analytical variables on FBC results and causes for erroneous results, including but not limited to;
   * Haemolysis
   * Icteric samples
   * lipaemia
8. Describe the limitations of the DxH900 and procedures in place to ensure accuracy of results.
9. What are the Internal Quality Control procedures and External quality assurance schemes in place at North Tees?

**7.1 Primary Investigation of Blood and its Components**

**7.1b - Erythrocyte sedimentation rate (ESR)/plasma viscosity**

1. Discuss the Principles of the method used at North Tees to measure ESR and the clinical relevance of the test.
2. How do environmental factors affect the accuracy of results?
3. Describe the Principles and purpose of measurement of plasma viscosity.
4. Complete the table below;

|  |  |  |  |
| --- | --- | --- | --- |
| Condition | ESR | PV | Neither |
| Chronic arthritis |  |  |  |
| Myeloma |  |  |  |
| Polycythaemia |  |  |  |
| Inflammation |  |  |  |
| Tuberculosis |  |  |  |
| Carditis |  |  |  |

1. Briefly discuss 3 disease conditions that can raise ESR and PV.
2. Why does sickle cell disease and polycythaemia decrease ESR?
3. Briefly describe when an ESR would be requested as an urgent test and why.
4. What are the reference ranges for both ESR and PV
5. Compare the advantages and disadvantages of the ESR and PV
6. What are the Internal Quality Control procedures and External quality assurance schemes in place at North Tees?

**7.1 Primary Investigation of Blood and its Components**

**7.1C** **- Identification and enumeration of peripheral blood cells by microscopy**

1. Discuss the Principles and application of light microscopy and how it is utilised in haematology.
2. Discuss the Principles and practice of staining blood cells by Romanowsky staining and the use of slide maker stainers
3. What are the Pre-analytical variables that will affect the appearance of blood cells and why?
4. How will the following red cell indices affect red cell morphology:
   * MCV
   * MCH
   * MCHC
   * RDW
5. Discuss in detail the mechanisms of normal haemopoiesis. Include how differentiations occurs to result in the production of mature;
   * RBC
   * Lymphocytes
   * Granulocytes
   * Platelets
6. With the use of diagrams discuss the normal morphological features of the myeloid and lymphoid series of white blood cells.
7. Discuss the significance of abnormal or immature white blood cells on the peripheral blood film
8. What are the Key features of blasts and signs of dysplasia.
9. Discuss the significance of abnormal platelet morphology and numbers on the peripheral blood film
10. What instances would you refer a blood film urgently to the consultant haematologist and why?

**7.1 Primary Investigation of Blood and its Components**

**7.1d Infectious mononucleosis**

1. The principles and practice of the screening test for infectious mononucleosis (IM)
2. What is the causative agent of Infectious Mononucleosis and why does in mainly affect younger adults?
3. What would you expect in a classical presentation of IM with regards to;
   * FBC results
   * Morphological findings
   * Further serology
4. What are the limitations of the IM screening test used at North Tees?
5. Why does a negative clearview result not rule out the possibility of Infectious Mononucleosis?
6. What are the internal quality control and external quality assurance schemes we participate in at north tees for IM?

**7.1 Primary Investigation of Blood and its Components**

**7.1e Screening test for sickle cell haemoglobin (HbS)**

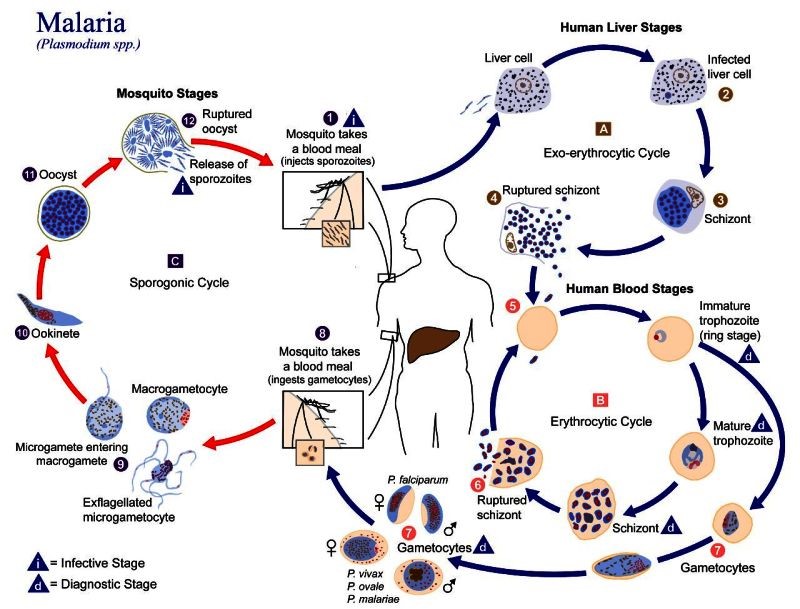
1. Briefly describe what Sickle Cell disease is and why we would screen for it in the hospital setting
2. Describe the Principles and practice of the screening test for sickle cell haemoglobin (HbS) used at North Tees.
3. What are the limitations of HbS screening test?
4. What are the Internal quality control and external quality assurance procedures followed for HbS screening?

**7.1 Primary Investigation of Blood and its Components**

**7.1f Bloodborne Parasites**

1. Complete the following table;

|  |  |
| --- | --- |
| Parasite | Geographical Occurrence |
| *P. Falciparum* |  |
| *P. Vivax* |  |
| *P. Malariae* |  |
| *P. Ovalae* |  |
| *P. Knowlesi* |  |

1. Describe the techniques for detecting the presence of human malaria parasites, including:
   * Thick and thin blood films
   * Use of different stains
   * Immuochromatography
   * Further testing available not performed at North Tees
2. Briefly describe the limitations of techniques employed for the detection of malaria in the laboratory
3. Discuss the life cycle of malarial parasites and the stages found in the blood using the following image.
4. Discuss the clinical presentation of suspected cases of malaria and associated haematological changes.
5. Describe the morphological differences between malaria species
6. What are the effect of drug treatment on detection of malaria in the laboratory?
7. Describe with the aid of a table the clinical presentation and morphological features of;
   * *Babesia*
   * *Trypanosoma*
   * *Filaria*
   * *Leishimana*
8. What are the Internal quality control and external quality assessment schemes at North Tees for blood borne parasite detection?

**7.1 Primary Investigation of Blood and its Components**

**7.1g – Coagulation screening**

1. Describe the components of the *in vivo* and *in vitro* haemostatic pathways and their modes of action.
2. Discuss the different principles and practice of techniques for measuring prothrombin (PT)
3. Principles and practice of the techniques for measuring activated partial thromboplastin time (APTT)
4. Which clotting factors are involved in the measurement of
   * PT
   * APTT
5. List and briefly describe the pre-analytical variables that can affect results.
6. Discuss the Principles and practice of the techniques available for measuring
   * Thrombin time (TT)
   * Reptilase time (RT)
7. Discuss the principles of different instrumentation used to assess haemostasis function.
8. Complete the table below;

|  |  |  |
| --- | --- | --- |
| **Test** | **Reference Range** | **Significance of Abnormal Result** |
| PT |  |  |
| APTT |  |  |
| Fibrinogen |  |  |
| Thrombin Time |  |  |
| Reptilase Time |  |  |

* + 1. Discuss the relationship between abnormal PT and APTT and other standard laboratory tests
    2. Briefly explain the effects of the following on PT, APTT and TT measurement;
* Low molecular weight heparins
* Vitamin K antagonists
* Xa inhibitors
* Direct Thrombin Inhibitors
* Unfractionated Heparin

1. What are the Internal quality control and the external quality assurance schemes we participate in for coagulation screening at North Tees?

**7.1 Primary Investigation of Blood and its Components**

**7.1h Fibrinogen**

1. Describe the condition of disseminated intravascular coagulation (DIC) and why is it a clinical emergency?
2. How is suspected DIC investigated in the laboratory and what results would you expect?
3. List 5 possible causes of DIC
4. Explain the different methods used for fibrinogen estimation
5. How is Fibrinogen measured at North Tees?
6. Describe the following conditions and discuss the differences.
   * + Afibrinogenemia
     + Hypofibrinogenemia
     + Dysfibrinogenemia.
7. List the Pre-analytical variables that can affect fibrinogen results and briefly explain why
8. What internal quality control and External quality assurance schemes do we participate in at North Tees?

**7.1 Primary Investigation of Blood and its Components**

**7.1i Fibrin degradation products**

1. Describe the principles and practice of tests used for D-dimer and FDP estimation include briefly manual methods.
2. What are D-dimers and why are these a more accurate indication of thrombus in the blood than FDPs?
3. Why is the D-dimer assay deemed to be a very sensitive tests but not very specific?
4. Discuss how the following affect D-Dimer result;
   * + Age
     + Anticoagulant therapy
     + Rheumatoid arthritis
     + Lipaemic samples
     + Icteric samples
5. What is the normal range for D-dimers – why can a normal result more useful clinically than an elevated one?
6. How is the D-Dimer test used in cases of suspected of venous thromboembolism (VTE)? – Include details of the different clinical scoring systems
7. Briefly discuss manual methods for FDP estimation
8. What are the internal quality control and external quality assurance we participate in for D-Dimer quantification at North Tees?

**7.1 Primary Investigation of Blood and its Components**

**7.1g Anticoagulant Therapy**

1. Describe the principles of heparin and vitamin K antagonist (VKA) therapy.
2. Describe the MOA, clinical use and principles and practice of monitoring of;
   * + Unfractionated heparin (UFH)
     + low molecular weight heparin (LMWH)
     + Danaparoid
     + Fondaparinux
3. Discuss the Principles and practice of the international normalised ratio (INR) system for monitoring VKA therapy.
4. What are the principles of instrumentation used to determine INR.
5. With the aid of a table discuss the therapeutic ranges of anticoagulants and the significance of out of range results.
6. What reversal agents are available for anticoagulants and how do these work?
7. How are direct thrombin inhibitor (DTI) and direct factor Xa inhibitor (DFXaI) monitored using standard coagulation tests?
8. What are the specific assays available for DTI and DFXaI?

**7.2 Iron Deficiency anaemia and iron overload**

1. Describe in detail the methods of normal erythropoiesis
2. Describe in detail the synthesis of haemoglobin
3. The diagram below shows the major organs and proteins involved in iron metabolism, transport and storage. Describe this process in detail using the diagram



1. What are the effects of both iron deficiency and iron overload on;
   * Red cell indices
   * Reticulocyte parameters
   * Red cell morphology.
2. Discuss clinical causes of;
   * Iron deficiency
   * Functional iron deficiency
   * Iron overload.
3. What Biochemistry tests are carried out at North Tees Hospital that will aid in the investigation of iron deficiency and iron overload - briefly describe how each test would be useful
4. What Pre-analytical variables can affect results of tests used to assess iron status?
5. State the normal reference values and the significance of abnormal results.
6. What internal quality control and external quality assurance schemes do we participate in at North Tees with regard to iron status?

**7.3 Haemolytic Anaemia**

**7.3a – Screening Tests**

1. Describe the causes of both hereditary and acquired haemolytic anaemia.
2. What are the Peripheral blood morphological features (intravascular and extravascular) associated with haemolytic anaemia? (include diagrams)
3. Discuss the principles of the following screening tests to identify haemolysis;
   * + Reticulocyte count
     + Serum haptoglobin
     + Haemosiderin
     + Methaemoglobin
4. What are the normal results for screening tests carried out at North Tees?
5. List the internal quality control and external quality assurance we participate in at North (Haematology department) that can directly or indirectly be associated to the laboratory investigation of haemolytic anaemia’s (e.g. G6PD)

**7.3 Haemolytic Anaemia**

**7.3b Inherited and acquired haemolytic anaemia**

1. Discuss the causes of both hereditary and acquired haemolytic anaemia
2. Describe the peripheral blood film picture you would expect in a patient presenting with haemolytic anaemia
3. Describe the metabolic pathways that occur in red cells, include the key aspects of the glycolytic pathway.
4. What are the principles and limitations of techniques to identify;
   * + Membrane abnormalities
     + Enzyme deficiencies
5. Describe the DAT assay and how it can be used to aid the laboratory diagnosis of haemolytic disease.
6. Describe the significance of both warm and cold reacting antibodies with regard to haemolytic anaemia
7. What are the principles and limitations of techniques to identify
   * + Acquired immune haemolytic anaemia
     + Acquired non-immune haemolytic anaemia
8. What are the normal reference values for tests described in this section and the significance of abnormal results?
9. The following are also red cell enzymopathies – briefly describe each and state what they all have in common?
   * + Hexokinase deficiency
     + Glucose phosphate isomerase deficiency
     + Phosphofructokinase deficiency
     + Aldolase deficiency
     + Triosephosphate isomerase deficiency (TPI)
     + Phosphoglycerate kinase deficiency (X-linked)
10. What internal quality control measures are in place and what external quality assurance schemes do we participate in at north tees with regards to testing for haemolytic anaemia?

**7.4 Abnormal Haemoglobins and Thalassaemia**

**7.4a Haemoglobin variants (e.g. HbS, C, D, E)**

1. Describe the normal structure of the haemoglobin molecule.
2. In no more than one paragraph for each describe the following haemoglobin variants:
   * + HbS
     + HbC
     + HbD
     + HbE
     + HbH
     + HbBarts
3. What are combined defects (e.g. HbSC, HbS/thalassaemia).
4. Describe the red cell indices and blood morphological features associated with haemoglobin variants.
5. What are the principles, practice and limitations of the following techniques for the detection and investigation of abnormal haemoglobin variants?
   * HPLC
   * Capillary electrophoresis
   * Isoelectric focusing
   * Mass spectrometry) for the detection and investigation of abnormal haemoglobin variants.
6. Reference values and the significance of abnormal results.
7. Internal quality control

**7.4 Abnormal Haemoglobins and Thalassaemia**

**7.4b Imbalanced globin chain production**

1. How does Imbalanced globin chain production lead to the thalassaemias?
2. Describe the globin chain composition of severe and trait forms of;
   * Alpha-thalassaemias
   * Beta-thallassaemias
   * HbH
   * HbBarts.
3. Discuss red cell indices and blood morphological features associated with the different types of thalassaemia.
4. What are the structural difference and significance between severe and trait form of thalassaemias.
5. What are the principles and practice of relevant techniques for the detection and investigation of imbalanced globin chain production.
6. Discuss the reference values and the significance of abnormal results.
7. What Internal quality control and external quality assurance schemes do we participate in at North Tees with regards to imbalanced globin chain production?

**7.4 Abnormal Haemoglobins and Thalassaemia**

**7.4c Unstable Haemoglobin**

1. Describe the mutations in globin chains leading to the production of unstable haemoglobin.
2. What are the red cell indices and blood morphological features associated with unstable haemoglobin.
3. Discuss the principles and practice of relevant techniques for detection of unstable haemoglobin.
4. What is the significance of abnormal results with regard to the detection of unstable haemoglobin?
5. What external quality assurance and Internal quality control schemes do we participate in at North Tees with regard to unstable haemoglobin?

**7.5 Macrocytic Anaemia – Vitamin B12 and Folate deficiency**

1. Discuss the metabolism of vitamin B12 and folate, and their role in haemopoiesis.
2. Describe the role of the folate cycle in cell production.
3. Describe the causes of vitamin B12 and folate deficiency.
4. What changes in blood cell indices and morphological features associated with vitamin B12 and folate deficiency?
5. Compare and contrast the differences between, and causes of, megaloblastic and other types of macrocytic anaemia.
6. How does B12 and folate deficiency affect both red cell morphology and indices?
7. How does folate deficiency contribute to neural tube defects.
8. What are the principles and practice of relevant techniques for the measurement of vitamin B12 and folate?
9. Discuss the limitations of tests for B12 and folate and list further investigations that may be required.
10. Complete the table below;

|  |  |  |  |
| --- | --- | --- | --- |
|  | Reference Range | Significance of High result | Significance of Low result |
| Vitamin B12 |  |  |  |
| Folate |  |  |  |

1. What are the internal quality control regimes and external quality assurance schemes we participate in at North Tees?

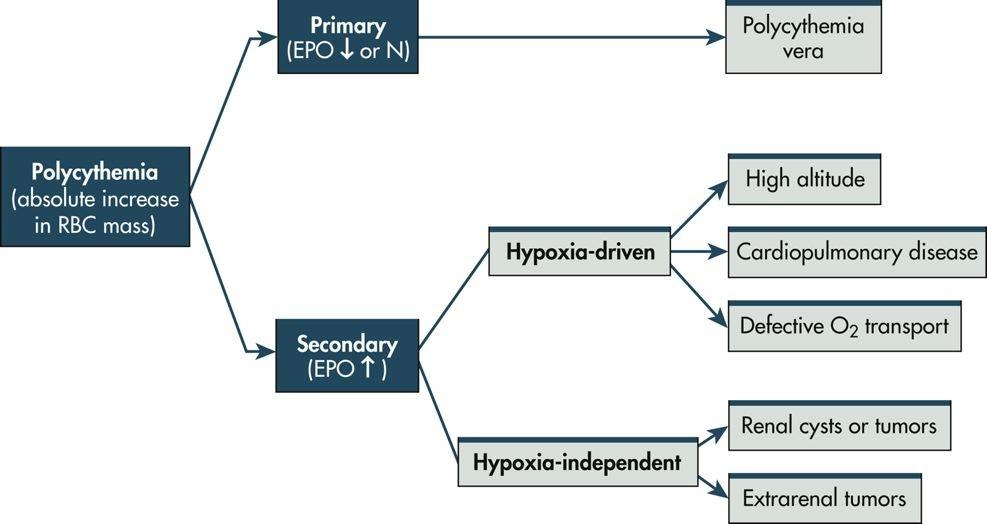
**7.6 Haematological Malignancies**

**7.6a – White Cell Malignancy**

1. Discuss the mechanisms of normal haemopoietic cell production and differentiation
2. What are the consequences of abnormality in normal cell differentiation?
3. Discuss the World Health Organization (WHO) classification of haematological malignancies and its practical applications.
4. Discuss the changes in peripheral blood cell indices are associated with white cell malignancy, including:
   * Leucocytosis
   * Leucopenia
   * Thrombocytopenia
   * Thrombocytosis
   * Anaemia
5. Describe the importance of accurately identifying Acute Promyelocytic Leukaemia. How is this treated and why?
6. Discuss the typical morphological indicators of malignancy, including:
   * leucoerythroblastic blood picture
   * Ring sideroblasts
   * Signs of dysplasia
7. Describe the morphological features and typical abnormal FBC results associated with the following malignancies:
   * Acute myeloid leukaemia
   * Acute lymphoblastic leukaemia
   * Chronic myeloid leukaemia
   * Chronic lymphocytic leukaemia
8. Describe in detail the classification of Myelodysplastic syndromes and myeloproliferative neoplasms.
9. Discuss features you would expect to find on a peripheral blood film and FBC results in a patient with;
   * MDS
   * MPN
10. Discuss the principles and application of relevant techniques for the investigation of white cell malignancies, including:
    * Bone marrow aspirate/trephine collection and examination
    * Immunophenotyping
    * Cytogenetics and molecular genetics
11. What are the limitations of the above tests and list further investigations that may be required.
12. State the relevant reference values
13. What are the Internal quality control and external quality assurance schemes we participate in at North Tees with regard to white cell malignancy?

**7.6 Haematological Malignancies**

**7.6b – Polycythaemia**

1. Polycythaemia can be relative (i.e. reduction in plasma volume) or absolute (increase in red cell mass) – the flow chart below shows the absolute causes of polycythaemia – discuss each
2. What are the mechanisms that lead to erythrocytosis and polycythaemia?
3. What changes in blood cell indices and morphological features would you expect to find in a patient with polycythaemia?
4. Discuss the principles and practice of relevant techniques for the investigation of increased red cell counts.
5. What is a JAK2 test, when would it be indicated and how is this request handled at North Tees?
6. Briefly describe other molecular markers for the diagnosis of myeloproliferative neoplasms.
7. The following table describes some of the clinical and laboratory investigations of suspected polycythaemia – describe each and what findings you would expect in polycythaemia. (BCSH guidelines):

|  |  |
| --- | --- |
| **Stage 1 Investigations** | **Stage 2 Investigations** |
| Clinical Evaluation | Cytogenetics |
| Pulse Oximetry | Bone Marrow Examination |
| Red Cell mass studies | Oxygen Dissociation Curve |
| Renal function | Sleep Study |
| LFT | Lung Function Tests |
| Abdominal Ultrasound | Gene Analysis |
| Ferritin and B12 |  |
| FBC |  |
| EPO |  |

1. What are the relevant reference values and the significance of abnormal results regarding polycytheamia?
2. What Internal quality control and external quality assessment procedures to we participate in at North Tees?

**Section 7.7 Haemostasis Abnormalities**

**7.7a Bleeding Disorders**

1. Describe the principles and components of the haemostatic pathways with regards to bleeding disorders.
2. Describe haemophillia A,B and C. Include monitoring and treatment of bleeding events in each case
3. Discuss Other factor deficiencies and their clinical relevance (Include reference ranges)
4. Discuss the different types of Von Willebrand disease
5. The list below contains common acquired coagulation disorders – describe how each can affect coagulation (no more than one paragraph for each):
   * Vitamin K deficiency
   * Anticoagulant therapy
   * DIC
   * Liver disease
   * Medications
   * Massive transfusion
6. Numerical and functional platelet disorders are common amongst patients with abnormal bleeding, laboratory tests for platelet disorders may include the following, describe each;
   * Assessing platelet number and size – count
   * Assessing platelet morphology – blood film
   * Screening tests of platelet function e.g. Activated Clotting Time, Bleeding Time, etc.
   * Light Transmission Aggregometry e.g. classical Born aggregometry.
   * Assessment of platelet nucleotides.
   * Flow cytometry e.g. to quantitate the presence or absence of platelet membrane glycoproteins
7. List the bleeding disorders you would expect to be associated with abnormalities in the following coagulation screening tests and why;
   * PT
   * APTT
   * TT
8. What are some of the complications with replacement therapy?
9. What are the principles, practice and limitations of techniques to assess
   * Specific coagulation factor deficiencies
   * Coagulation factor inhibitors
   * Platelet function.
10. What are the Pre-analytical variables that can affect results of tests used to investigate bleeding disorders?
11. What are the differences between assays in the diagnosis of a deficiency and monitoring of treatment?

**Section 7.7 Haemostasis Abnormalities**

**7.7b Thrombotic Disorders**

1. Describe natural inhibitors of the haemostatic pathways and their MOA
2. What are the thrombotic risks associated with reduced levels of inhibitors and co-factors
3. What are the thrombotic risks associated with genetic defects in the following and how are these tests performed at North Tees?
   * Factor V Leiden
   * Prothrombin G20210A gene mutation
4. The following table shows three categories of techniques involved in the investigation of thrombotic risk. Discuss in detail the principles and practice of each including the effect of preanalytical variables on each

|  |  |  |
| --- | --- | --- |
| **Clotting** | **Chromagenic** | **Immunoassay** |
| Protein C activity | Antithrombin activity | Free Protein S |
| Protein S activity | Protein C activity | Protein C Antigen |
| Activated protein C resistance |  | Antithrombin antigen |

1. What are the normal reference values for the tests mentioned above and the significance of abnormal results?

**7.7 Haemostasis abnormalities**

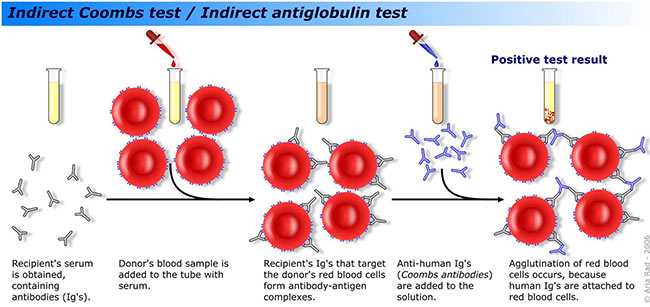
**7.7c Lupus anticoagulant**

1. What is meant by the term ‘lupus anticoagulant’?
2. When would a lupus be indicated following initial coagulation screening results?
3. Discuss the Principles and significance of the screening tests for coagulation and the potential influence of lupus anticoagulants on them.
4. What are the effect of lupus anticoagulants on clotting based tests such as the INR and one-stage factor assays?
5. What relationship does Lupus anticoagulant have with antiphospholipid antibodies?
6. What is the method used for lupus anti coagulant investigation at North Tees?
7. What procedures can be used to distinguishing lupus anticoagulants from other causes of elevated clotting times.
8. Describe the Pre-analytical variables that can affect results of lupus testing and sample timing requirements.
9. What is the significance of an abnormal result (include normal ranges)?
10. What internal quality control do we perform at North Tees and External quality assurance programmes do we participate in?

**Section 8.1 Patient and Donor ABO/D Typing and Antibody Screening**

**8.1a Routine ABO/D typing and antibody screening**

1. “The ABO antibodies are of major clinical significance in transfusion medicine for two reasons: they are naturally occurring and are found universally, and, they are highly reactive”.
   * + Discuss the ABO blood group system
     + Why are these antibodies termed naturally occurring?
     + What Ig class of antibodies make up the ABO system?
     + Why are these antibodies found almost universally?
     + Why is (using for the reasons answered above) the ABO blood group system then the most clinically significant?
2. Describe the Rh blood group system and include the following:
   * + % of Rh D positive and Rh D negative in the UK
     + Why is it deemed the second most important blood group system clinically?
     + How an individual may acquire / produce Rh D antibodies
     + What are the main antigens that comprise the Rh system?
     + How these antigens differ from those found in the ABO blood group system.
     + How these antibodies (when produced) differ from those found in the ABO blood group system?
     + What is meant by “weak D” and “partial D”
3. Why are two clones of anti-D reagents used in transfusion department?
4. Why should enzyme treated cell results be interpreted with caution? What are the advantages of using this method?
5. Discuss other clinically relevant blood group systems and their implications on transfusion
6. The image below shows an overview of the indirect antiglobulin test (IAT), describe the image;



1. What is the different between the IAT and DAT assay?
2. Describe how the following factors can affect antigen – antibody reactions (in context of blood grouping / antibody screening):
   * + Temperature
     + pH
     + Ionic strength
     + Enzyme treatment
     + Potentiators (e.g. proteolytic enzymes)
     + Antibody / antigen concentration
     + Antigen Zygosity
     + Length of incubation
3. Describe in detail the principles and appropriate use of serological tests used in manual and automated blood grouping and antibody screening.
4. How is Increased security afforded by the electronic transfer of ABO/D and antibody screening results from automation to the LIMS?
5. List the specifications of reagents for patient blood grouping and antibody screening include the rationale behind their selection and controls required depending on the testing system and methods used.
6. Describe how the validation of reagents prior to use is performed at North Tees and detail what actions would you take in any cases where validation fails
7. What are the minimum specifications for blood grouping in;
   * + Emergency situations
     + Before the issue of group compatible blood
8. When would a manual tube group be performed at North Tees hospital?
9. Discuss the relevance of erroneous and anomalous results of patient testing
10. What Internal quality control schedules are in place at North tees and what external quality assessment schemes do we participate in?
11. List the SOP’s that are relevant to blood group and antibody screening
12. What are the national guidelines relating to blood group and antibody screening?

**Section 8.1 Patient and Donor ABO/D Typing and Antibody Screening**

**8.1b Investigation of ABO and RhD anomalies**

1. What are the clinical and laboratory factors that may;
   * + Affect results of ABO/D typing
     + lead to anomalous results of ABO/D typing.
2. Discuss the principle and practice of investigating blood group anomalies in general and how they differ in the following patient groups;
   * + Paediatric
     + Elderly
     + Immunosuppressed
3. What are the principles and practice of investigating blood group anomalies in various clinical and technical scenarios, including:
   * + Hemopoietic stem cell transplantation
     + Presence of cold agglutinins
     + Transfusion reactions
     + Potential ‘wrong blood in tube’
4. Discuss the scientific basis and significance of ABO subgroups and weak/partial D types in patients.
5. When would weak/partial D be sent for further testing and why?
6. Briefly explain the limitations of testing when using rare antisera.
7. How do anomalous grouping results affect decisions made in clinical and laboratory circumstances with regard to the selection of safe and appropriate components for the patient?
8. What are the criteria and trigger factors for further testing when an anomalous group is encountered before a blood group can be assigned?
9. When would you refer a sample to NHSBT?

**Section 8.2 Antibody Identification**

1. Discuss the significance of red cell antibodies in pre-transfusion testing from clinically significant blood group systems.
2. Describe the mechanisms of antigen:antibody reactions and their role in *in vivo* red cell destruction.
3. What are the principles, practice and application of the range of tests available to aid antibody identification?
4. Using the BSH guidelines describe
   * + How to interpret results and positively identify antibody specificities
     + Exclusion of antibodies as part of the antibody identification process
     + Recognising when a sample requires further testing
5. Give examples in your portfolio of simple and complex antibody investigations you have carried out. Describe how you are able to identify the antibody or antibodies e.g. technique etc.
6. What is dosage and how might it be relevant when interpreting an antibody panel sheet result?
7. Explain why a patient’s phenotype is an important part of the antibody investigation
8. If you cannot identify an antibody using all available techniques, what steps would you then take?
9. Internal and external quality assurance procedures.
10. List the national guidelines relevant to antibody identification

**Section 8.3 Red Cell Phenotyping**

* 1. Discuss the relevance of red cell phenotyping in pre-transfusion and antenatal testing.
  2. What is the rationale for extended red cell phenotyping for patients on long-term transfusion support, and know which groups of patients may require blood matched for antigens other than ABO and D?
     + List specific groups of patients this is applicable to
  3. Describe situations in which red cell phenotyping cannot be performed and genotyping is required.
  4. Why is the selection of reagents and controls for red cell phenotypes important and how is this performed?
  5. How do we ensure reagents in use for phenotyping are validated?
  6. What is the relevance of antithetical groups when performing red cell phenotypes.
  7. What Internal quality control and external quality assessment procedures with regards to red cell phenotyping?
  8. What are the local policies and procedures and national guidelines in place covering all of the above. List them below.

**Section 8.4 Selection of Red Cell Components**

1. What are the criteria for the selection of donors and the mandatory tests performed on all donations.
2. What specific patient groups requite extended and additional testing to be performed on donations and why, for example neonates?
3. What are the principles of blood component preparation, and the range of blood components available?
4. How to interpret tests and their results from other areas/disciplines of pathology (e.g. haematology and coagulation) in clinical context to determine transfusion requirements.
5. Are there any alternatives to allogeneic blood transfusion? Discuss scenarios when this would be useful.
6. Explain the Importance of communication with all staff groups involved in effective provision of transfusion support in both routine and emergency situations.
7. What are the criteria for selection of red cells and components for patients with clinical conditions listed below;
   * + Haematopoietic Stem Cell Transplant
     + Intrauterine Transfusion
     + Neonatal
     + Auto-immune Haemolytic Anaemia
     + Solid organ transplants
     + Red cell antibodies
8. What is the rationale for selection of red cells and components with the following additional specifications.
   * + Irradiated
     + CMV negative
     + HbS negative
     + K- for females of child-bearing potential
     + Phenotyped matched
9. What are the relevant internal quality control and external quality assessment procedures in place at North Tees?

**Section 8.5 Pre-Transfusion Testing Procedures**

1. What is the Importance of pre-transfusion testing in establishing compatibility?
2. What do you understand the value of a historical records in pre-transfusion procedures?
3. Discuss the role of IT and automation in improving security in pre-transfusion testing.
4. Although not currently in place at North Tees, electronic issue enables rapid issue of specific blood to a patient. Discuss the criteria for suitability of samples for electronic issue.
5. What is remote issue and explain where this would be useful, for example multi-site trusts.
6. If electronic issue was in place, discuss the instances where a serological crossmatch would still be required.
7. What are the principles and practice of serological compatibility testing.
8. After performing a cross match you observe a positive reaction. Detail the steps you would take to investigate an incompatible serological crossmatch.
9. What are the Internal quality control and external quality assessment procedures in place with regard to pre-transfusion testing?
10. What are the relevant SOP’s to this section, and list the BSH guidelines that are applicable

**Section 8.6 Issue of Blood Components and Products**

1. Describe the correct procedures for the labelling and issue of blood components and products by the transfusion laboratory for patient use.
2. What is ISBT128 and how is this relevant to your role?
3. Discuss both local and national guidelines relevant to the issue of blood components and products
4. List storage requirements and expiry times for FFP and cryoprecipitate once it has been thawed.
5. Using the table below discuss the relevant storage and transport criteria for issued blood components/products.

|  |  |  |
| --- | --- | --- |
| **Component** | **Storage** | **Shelf Life** |
| RBC |  |  |
| Platelets |  |  |
| Cryoprecipitate |  |  |
| FFP |  |  |
| RBC in additive |  |  |
| Washed RBC |  |  |
| RBC for neonatal exchange transfusion |  |  |
| RBC for neonatal top up transfusion |  |  |
| Irradiated RBC |  |  |
| Granulocytes |  |  |

1. All blood components must be traceable from ‘vein-to-vein’ describe what this means by discussing the following terms in detail;
   * Traceability
   * Recall – Use an example you have been involved with
   * Restocking
   * Disposal of blood and blood components

**Section 8.7 Blood Stocks Management**

1. What is the blood stocks management system (BSMS) and why is it used?
2. The following areas have potential risks associated with the care and handling of blood components and products:
   * Transportation
   * Temperature
   * Physical handling
   * Documentation
   * Training
   * Equipment (e.g. storage, defrosters)
   * Labelling
   * Receiving and issuing
   * Quarantine and disposal
   * Remote sites

Describe each and how the risks are mitigated (both inside and external to the transfusion department

1. Why are storage and transport conditions monitored?
2. Describe the following principles concerning appropriate use of blood and blood components:

* Appropriate use (e.g. clinically)
* Product selection
* Transfusion risks
* Donor selection and testing
* Avoiding unnecessary transfusions
* Laboratory testing
* Conserving stocks
* Right patient, right blood

1. The Blood Safety and Quality Regulations (BSQR) require “unambiguous traceability” of all blood and blood components from donor to patient (or final disposal if not transfused) and vice versa:
   * + What is meant by the term unambiguous traceability?
     + How long should transfusion records be kept for?
     + What sort of records should be kept that might aid traceability?
     + Why is traceability from donor to patient / disposal important within transfusion?
     + If the final fate of a specific blood component cannot be confirmed what follow up actions should be taken?
     + How does the transfusion department at North Tees and Hartlepool hospital confirm and record that a transfusion has taken place?
2. Describe how blood stocks are managed on a daily/weekly basis within North Tees. Include stock rotation & OBOS.
3. How would blood stocks be managed on a local & national basis if there was a ‘critical’ shortage of blood in the UK?
4. What SOP’s are relevant to BSMS and how are these related to national guidelines?

**Section 8.8 Adverse Reactions and Events in Transfusion**

1. The following diagram shows the main classifications and characteristics of transfusion reactions. Discuss each.



1. Discuss the metabolic adverse effects of blood transfusion
2. Discuss the role of each of the following in ensuring the safety of blood transfusion;
   * MHRA
   * SABRE and SHOT
   * SaBTO
   * UKAS
   * BSQR
   * GMP
3. How would you complete a request for a suspected transfusion reaction?
4. What are the differences in the process for internal and external recall at North Tees?
5. What are the principles and application of root cause analysis?

**Section 8.9 Antenatal Testing Procedures**

1. List the routine transfusion tests carried out at North Tees hospital for antenatal screening.
   * + How frequently are these tests carried out?
     + Are there any special sample requirements for any of these?
     + When and what follow up tests could be carried out and in what situations?
     + Does the paternal blood group have any relevance during antenatal testing procedures?
2. Are there any specific reagents you could use to help identify when a sample would require a full antibody identification or not in a pregnant woman who you suspect has been given prophylactic anti-D?
   * + Detail this process
     + When would you refer a sample for further testing
     + What information would you look for on either the request form or patient history?
3. What are the requirements for antenatal and post-natal follow up testing where clinically significant antibodies are detected? – Include the frequency of re-testing and methods used for various antibodies
4. How does good communication to enable the successful management of pregnancies in women with red cell antibodies?
5. Describe in detail the principles and application of routine antenatal anti-D prophylaxis (RAADP) and how this is followed at North Tees.
6. Discuss the principles of acid-elution staining and flow cytometric methods for measuring foetal maternal haemorrhage (FMH)
7. Using a flow chart show the method used for kleihauer investigations at North Tees
8. When would you refer a sample for follow-up testing when performing a kleihauer?
9. How is the correct dose of prophylactic anti-D immunoglobulin calculated?
10. What are the current guidelines surrounding antenatal testing procedures? - list the relevant SOP’s to this section you use

**Section 8.10 Haemolytic Disease of the Fetus and Newborn**

1. Discuss the aetiology of haemolytic disease of the fetus and newborn (HDFN).
2. Describe in detail the significance of red cell antibodies in HDFN include frequency of retesting, the method used and how each cause HDFN
3. The specific antibody detected will determine the method by which the levels are measured. Further discuss the criteria and methods for quantification of antibodies in pregnancy.
4. Why is it essential to be able to differentiate between immune and prophylactic anti-D?
   * + What procedures are in place at North Tees to ensure immune anti-D is identified
5. Discuss the role of paternal testing and fetal genotyping in monitoring HDFN.
6. What are the routine testing procedures performed on neonates at North Tees?
   * + How does this differ when the mother has red cell antibodies?
7. Describe the transfusion requirements for the treatment of HDFN.
8. How does the criteria for the selection of blood for; intrauterine transfusion (IUT), exchange and top-up transfusions differ from routine units?

**Section 8.11 Investigation of Red Cell Autoantibodies**

1. Discuss the main reasons for in vivo sensitisation of red cells with immunoglobulins and/or complement in autoimmune haemolytic anaemias and post-transplantation.
2. How can antibody adsorption methods be used to distinguish between alloantibodies and autoantibodies?
3. Describe the mechanism of in vivo red cell destruction.
4. What are the principles and practice of direct antiglobulin techniques (DAT) using poly- and monospecific antiglobulin reagents?
5. You have a patient with a positive DAT, how does this influence the results of pre-transfusion testing?
6. Describe what you would do to ensure the safe blood provision for a patient with autoantibodies.
7. What are the Internal quality control and external quality assessment procedures in place at North Tees that are relevant to this section?
8. When a sample requires further testing how do you interoperate these results when they are received back?