Unit title: The Immune Response System

Unit code: **M/601/0228**

QCF level: **5**

Credit value: **15**

Aim

This unit develops an understanding of the function and manipulation of the immune system and its abnormalities. Learners also acquire skills in immunological techniques.

Unit abstract

The ability to understand and utilise the immune response is of utmost importance for people working in biomedical science to ensure the effective control, treatment and prevention of disease. Understanding the immune system and its constituents enables medical personnel to understand and control many autoimmune disorders. Learners will appreciate the role the skin, mucus membranes, soluble substances such as cytokines and complement, and the inflammatory response play in defending the body against disease. Learners will also appreciate the importance of the leukocyte group and antibodies in preventing and combating invasion by foreign antigens.

The unit will enable learners to understand the difference between primary and secondary immune responses and active and passive immunity. Learners will understand how to raise vaccines and how to use elements of the immune response as therapeutic agents. The unit also provides an opportunity to appreciate the role of the immune system in tissue transplantation.

Learning outcomes

On successful completion of this unit a learner will:

1 Understand the innate immune response

2 Understand the acquired immune response

3 Understand the methods used to manipulate the immune response

4 Understand the mechanisms and consequences of an abnormal immune response

5 Be able to carry out a range of immunological techniques used to study the immune system.

Unit content

1 **Understand the innate immune response**

Skin and mucus membranes: structure of the skin; langerhans and granstein cells; keratin; sebum; perspiration; lysozyme; mucus; cilia escalator; lacrimal apparatus; urine

Complement system: complement; complement cascades

Cytokine network: interferons; interleukins; tumour necrosis factors

Leukocytes: granulocytes (neutrophils, basophils, eosinophils); monocytes; macrophages; dendritic cells

Inflammation and phagocytosis: process of inflammation; mononuclear phagocytic system; mechanism of phagocytosis

2 **Understand the acquired immune response**

Lymphatic system: primary and secondary lymphoid organs; the lymph node

Lymphocytes: B lymphocytes; cytotoxic T cells; helper T cells; suppressor T cells; natural killer cells

Antigen presentation: major histocompatibility complex (MHC); role of macrophages; foreign antigen – MHC complexes

Antibody (immunoglobulin) molecules: prevalence and function of the five classes of antibody; structure of a typical antibody molecule; antibody function

Antibody mediated response: activation of B cells; role of interleukins and T cells; clonal selection; plasma cells; memory cells

Cell mediated response: activation of T cells; cytotoxic T cells; substances secreted by cytotoxic T cells to include perforins, granzymes and lymphotoxins; memory cells

3 **Understand the methods used to manipulate the immune response**

Vaccination: primary and secondary response; active immunity; passive immunity; methods of raising vaccines

Transplantation: issues e.g. rejection, manipulation

Clinical uses of the immune response: applications e.g. tumour immunology, cytokines as therapeutics

4 **Understand the mechanisms and consequences of an abnormal immune response**

Hypersensitivity reactions: Type I (allergic reactions); Type II (cytotoxic reactions); Type III (immune complex reactions); Type IV (cell mediated reactions)

Autoimmunity: responses to self-antigens eg multiple sclerosis, Addison's disease, type 1 diabetes, rheumatoid arthritis, Graves disease

Immune deficiencies: congenital and acquired eg DiGeorges syndrome, Wiskott-Aldrich Syndrome, X-linked Agammaglobulinemia (XLA), selective Immunoglobulin A (IgA) deficiency, Severe Combined Immunodeficiency (SCID), Acquired Immune Deficiency Syndrome (AIDS)

5 **Be able to carry out a range of immunological techniques used to study the immune system**

Methods to study constituents of the immune system: flow cytometry; enzyme-linked immunosorbent assay (ELISA) to include detecting cytokines using beads attached to antibodies; intracellular cytokine analysis; magnetic cell sorters (MACS); cell sorters

Immunological molecules as diagnostic tools: ELISA; immuno-cytochemistry; complement fixation test; immunodiffusion test; tetramer/pentamer technology

Diagnostic immunological techniques: agglutination reactions; white blood cell counts; ELISA; immunodiffusion test

Case studies: apply results of diagnostic procedures to patient scenarios and case studies

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	**Assessment criteria for pass** The learner can:
LO1 Understand the innate immune response	1.1 explain the role of the skin and mucus membranes in the inflammatory response 1.2 describe the complement system 1.3 explain the importance of the cytokine network as an integral part of the immune system 1.4 identify the leukocytes involved in the innate response 1.5 explain the major phases of the inflammatory response, including phagocytosis
LO2 Understand the acquired immune response	2.1 describe the locations and functions of lymphatic tissues 2.2 identify the types of lymphocytes and the role they perform in the acquired immune response 2.3 explain how antigen presentation occurs via MHC interaction 2.4 review the structures and functions of antibody molecules 2.5 explain the antibody mediated and cell mediated immune response
LO3 Understand the methods used to manipulate the immune response	3.1 discuss the strategies used in active and passive vaccination 3.2 assess the issues associated with tissue transplantation 3.3 explain the potential clinical uses of components of the immune system
LO4 Understand the mechanisms and consequences of an abnormal immune response	4.1 explain the differences between the four types of hypersensitivity reaction 4.2 describe autoimmune responses using a range of clinical examples 4.3 review examples of congenital and acquired immune deficiencies

Learning outcomes On successful completion of this unit a learner will:	**Assessment criteria for pass** The learner can:
LO5 Be able to carry out a range of immunological techniques used to study the immune system	5.1 describe the methods used to study the major constituents of the immune system 5.2 review the methods of using immunological molecules as diagnostic tools 5.3 safely carry out practical diagnostic immunological techniques and apply results to case studies of patients.

Guidance

Links

This unit has particular links with the following units within this qualification:

- *Unit reference number T/601/0215: Cell Biology*
- *Unit reference number L/601/0219: Laboratory Techniques for Applied Biology*
- *Unit reference number F/601/0220: Analysis of Scientific Data and Information*
- *Unit reference number F/601/0217: Biochemistry of Macromolecules and Metabolic Pathways*
- *Unit reference number J/601/0218: Physiology of Cellular Systems in Animals*
- *Unit reference number L/601/0222: Laboratory Management*
- *Unit reference number Y/601/0224: Neurophysiology and Homeostatic Control of the Human Body*
- *Unit reference number D/601/0225: Molecular Biology and Genetics*
- *Unit reference number M/601/0231: Infectious Diseases*

Essential requirements

Delivery

Delivery must emphasise the relationship between the strategies the body uses to prevent and combat infection and the strategies used by pathogenic micro-organisms to cause disease.

Rapid diagnostic assays or kits must be used as part of the laboratory programme. Tutors must emphasise the importance of health and safety throughout delivery and assessment of learning outcome 5 (immunological techniques). Learners must understand the importance of adhering to laboratory health and safety guidelines when working with blood serum and live tissue. Practical tasks must include risk analyses consistent with COSHH guidelines.

Industry links, work placements and visits from personnel with technical expertise in using immunological diagnostic techniques would enhance delivery of this unit.

Assessment

Learning outcomes 1 and 2 involve gaining the basic knowledge of the innate and acquired immune responses. The microscopic examination of different leukocytes must be carried out and written evidence of this provided.

For learning outcome 3, learners must understand how the immune response can be manipulated to prevent disease and confer immunity. Learners also need to understand the role of the immune response in organ transplantation and the potential of elements of the immune systems to be used as clinical tools.

Learning outcome 4 requires learners to understand the mechanisms and consequences of an abnormal immune response. Evidence could be in the form of presentations on individual autoimmune responses and congenital and acquired deficiencies.

Learning outcome 5 involves learners carrying out laboratory investigations, handling medical specimens safely, interpreting results from a range of diagnostic methods and applying them to medical situations or case histories. A differential white cell count, agglutination reactions, immunodiffusion and ELISA must be performed. The techniques used will depend on the equipment available in the centre but must encompass serological methods and the use of manufactured diagnostic kits. Learners must provide evidence of performing the appropriate immunological techniques, supported by assessor observation records. Evidence of applying laboratory results to patient scenarios must also be provided. Learning outcome 5 requires learners to become familiar with the techniques used to study the constituents of the immune system, including flow cytometry.

Resources

Learners require access to a laboratory with suitable equipment for carrying out immunological techniques.

Employer engagement and vocational contexts

This unit gives learners the opportunity to understand the immune system and to carry out immunological techniques. Learners will have opportunities to appreciate the importance of immunology as a valuable tool in diagnostic research. Learners would benefit from visits to industrial immunology facilities to observe the practical applications of immunology in operation. Learners would also benefit from visits to centres with flow cytometry and magnetic cell sorting facilities.

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