Disorders of the immune system reports examples

Health & Medicine

Introduction

The immunological disorders in an individual can occur due to three different reasons. This includes immunological diseases in an immunocompromised individual, or “ autoimmune diseases”, or finally an immunological hypersensitivity that can lead to tissue damage.

Immunodeficiency diseases

Immunodeficiency diseases occur due to malfunctioning of the organs or cells in an individual. They are further classified as primary immunodeficiency (PID) and secondary immunodeficiency (SID).

Primary immunodeficiency disease

They occur when there is a direct defect in the immune system. They are further classified into eight groups depending upon the site of the defect. Combined T and B deficiencies. Severe Combined Immunodeficiency (SCID) is an excellent example of combined T and B deficiencies. It involves decrease in both B and T cells or increase in the number of B cells. The consequences of SCID include chronic viral and fungal infections. This disease occurs in infants and is treated with antibacterial, antiviral and antifungal drugs.

Antibody deficiencies. Agammagloubulinemias or hypogammaglobulinemias is the term used to describe the deficiency of immunoglobulins. Depending on the level of deficiency, they can be further classified. Transient hypogammaglobulinemia occurs in infants if the production of IgG is delayed. Common variable immunodeficiency (CVID) involves immunodeficiency of all classes of the antibodies. CVID patients show recurrent pyrogenic infections

and may involve organisms like Streptococcus pneumonia and Staphylococcus aureus. X-linked agammaglobulinemia (XLA) or Bruton’s disease involves a deficiency in Bruton’s tyrosine kinase (Btk). Treatment involves administering antibiotics. Selective IgA deficient individuals are asymptomatic or may involve recurrent infections. Few patients can also have both IgA and IgG deficiency and hence suffer more bacterial infections.
The DiGeorge anomaly and the Wiskott Aldridge syndrome. The DiGeorge anomaly is an excellent example of a developmental disorder involving organs that develop from the third and the fourth pharyngeal embryo pouches. There is a deletion or a partial monosomy of chromosome 22. The characteristics of DGA include facial abnormalities, hypoparathyroidism and hypocalcemia. Deletion in chromosome 22 is detected by fluorescence in-situ hybridization (FISH).
The Wiskott-Aldridge syndrome (WAS) results due to the mutation in the WAS gene, present on the short arm of the chromosome 22, coding for cytoskeletal protein sialophorin. The characteristic include a decrease in the IgM levels and increase in IgE and IgA. WAS can be treated by administering antibiotics for infections and platelets for blood transfusion along with immunoglobulin replacement.
The Chediak-Higashi syndrome (CHS). It is a rare autosomal disorder that results due to mutations in the CHS1 gene on chromosome 1. CHS1 gene product plays a role in intracellular transport of proteins and in the synthesis of storage granules. This syndrome leads to recurrent bacterial and viral infections. Infants show recurrent skin infections, progressive neurological dysfunction, and mental retardation. Children suffering from CHS may be treated by bone marrow transplant and antibiotics against bacterial and viral

infections.

Phagocytic defects. Monocytes, macrophages and neutrophils are phagocytic cells that kill ingested bacteria. Chronic granulomatous disease (CGD), an example of phagocytic defect, is an inherited disorder of phagocytic cells that are unable to generate the reactive oxygen intermediates, required to produce bactericidal compounds, such as hydrogen peroxide. Children below the age of five years suffer from CGD. The characteristics include skin infections, pneumonia and gastroenteritis. Treatment involves bone marrow transplantation.

Leukocyte adhesion deficiency (LAD) results due to the incapability of the leukocytes to express cell adhesion molecules that are required for their movement though the walls of blood vessels during inflammation. They are of two forms. LAD1 is characterized by localized bacterial infections while, patients with LADII suffer from repeated infections and growth and mental retardation. LADI can be treated with bone marrow transplantation.

Complement deficiencies. Activated complement plays a role in bacterial lysis, stimulation of the inflammatory response, promotion of phagocytosis and in clearing the immune complexes. Complement may be activated by the classical pathway, the alternative pathway or the lectin pathway. Deficiency in the complement proteins such as, CIq, C1r C1s, C4, C2 and C3 results in the increase in the immune complex disorders like SLP and vasculitis. Deficiency in C5, C6, C7, C8, and Factor D and P result in recurrent neisserial infections.

Autoimmune disorders

The immune system does not usually mount an immune response against ‘ self’. However, when the immune system attacks self antigens, it results in a number of autoimmune disorders. Autoimmune disorders are classified as organ-specific or systemic.

Examples of autoimmune disorders

Autoimmune thyroiditis, also known as Hashimoto’s thyroiditis, is an autoimmune disorder affecting the thyroid gland that results in hypothyroidism and myxedema. The disease is seen in middle aged women who are overweight, lethargic and are constipated. Detection is done by ELISA. Treatment involves administering thyroxine to treat myxedema.

Antiglomerular basement membrane diseases include Goodpasture’s disease that shows glomerulonephritis, pulmonary hemmorhage and the Goodpasture’s syndrome that is similar but without the antibodies. Treatment is by removing the circulating antibodies by plasmapheresis and administering immunosuppressant drugs.

Patients suffering from Myasthenia Gravis (MG), another autoimmune disorder, produce antibodies to acetylcholine receptors. Thus the receptors fail to respond to acetylcholine. This results in weakness of skeletal muscles, breathing and facial muscles. Treatment includes administering immunosuppressant drugs and cholinesterase inhibitors and by performing thymectomy.

Rheumatoid arthritis (RA) is characterized by symmetrical arthritis and radiological changes to the bone. Rheumatoid factor (RF) is an IgM class antibody directed against IgG. Characteristics include joint inflammation with

long term remission and intermittent ‘ flares’. Detection of RA is done with RoseWaaler test. RA can be treated with immunosuppressive drugs like methotrexate and anti-inflammatory drugs.

Systemic lupus erythematosus (SLE) is characterized by the presence of antinuclear antibodies (ANAs) in the plasma. Inflammation caused due to the deposition of immune complexes affects many organ systems. Clinical features include arthritis, skin rash, particularly the butterfly rash of the face. Symptoms vary in different patients. Diagnosis can be done by indirect immunofluorescence, RIA or by ELISA. Treatment is by immunosuppressive drugs like azathioprine or cyclosporine.

Immunological hypersensitivity

These are disorders in which an immune response is mounted against a foreign immunogen resulting in tissue damage. They are further of four different types. In type I hypersensitivity, effects are seen within eight months of immunogen exposure. Few immunogens that can cause allergic reactions are known as allergens. The main reason for this type of hypersensitivity is the production of IgE against an immunogen. There are different disorders with varying effects on the body. In allergic rhinitis, the effect is seen in upper respiratory tract. A skin rash may develop in people suffering from food allergies. In people suffering from allergic asthma, severe inflammation in respiratory tract is seen. Type I hypersensitivity I can be treated by avoiding the allergen or by administering antihistamines or anti-inflammatory drugs.

In type II or cytotoxic hypersensitivity, the antibody activates the complement causing tissue damage. Transfusion reactions to mismatched

blood and hemolytic disease of the newborn (HDN) are few examples of type II hypersensitivity.

Type III or complex-mediated hypersensitivity results due to immune complexes involving antibodies to soluble antigens. This can be harmful and can further cause tissue damage. Examples include occupational diseases like Farmer’s lung.

Type IV delayed type hypersensitivity (DTH) becomes apparent after 18 hours of exposure to an immunogen. It is caused by T lymphocytes rather than antibody and is typified by Mantoux reaction. It is seen in contact allergies to a number of chemicals like hair dyes, biological stains and plant biochemicals. Treatment involves avoiding the allergen.