2 Immunity – Active and Passive

■ 2.1 Immunity can be induced, either actively (long term) or provided by passive transfer (short term), against a variety of bacterial and viral agents.

■ 2.2 **Active immunity** is induced by using inactivated or attenuated live organisms or their products. Live attenuated vaccines include those for poliomyelitis (OPV), measles, mumps and rubella, and BCG vaccine. Bacterial vaccines such as pertussis, wholecell typhoid, and inactivated poliomyelitis virus (IPV) vaccines contain inactivated organisms. Others such as influenza and pneumococcal vaccine contain immunising components of the organisms; tetanus and diphtheria vaccines contain toxoid - that is, toxins inactivated by treatment with formaldehyde.

■ 2.3 Vaccines produce their protective effect by inducing cell mediated immunity and serum antibodies which can be demonstrated by their detection in the serum. Live vaccines promote cell mediated immunity, which, after BCG immunisation, is demonstrated by a positive tuberculin skin test.

■ 2.4 A first injection of inactivated vaccine or toxoid in a subject without prior exposure to the antigen produces a slow antibody or antitoxin response of predominantly IgM antibody - the primary response. Two injections may be needed to produce such a response. Depending on the potency of the product and time interval, further injections will lead to an accelerated response in which the antibody or antitoxin titre (IgG) rises to a higher level - the secondary response. Following a full course, the antibody or antitoxin levels remain high for months or years, but even if the level of detectable antibody falls, the immune mechanism has been sensitised and a further dose of vaccine reinforces immunity.

■ 2.5 Some inactivated vaccines contain adjuvants (substances which enhance the antibody response). Examples are aluminium phosphate and aluminium hydroxide which are contained in adsorbed diphtheria/tetanus/pertussis vaccine and adsorbed diphtheria/tetanus vaccine.

■ 2.6 In many individuals, live attenuated virus vaccines such as measles, mumps and rubella promote a full, long-lasting antibody response after one dose. Live poliomyelitis vaccine (OPV) requires three doses. An important additional effect of oral poliomyelitis vaccine is the establishment of local immunity in the intestine.

■ 2.7 Viruses that are used for production of vaccines must be grown in cells. A variety of cell types are used for this purpose. Some viruses (measles, mumps, yellow fever, influenza) are grown in chick cells; some polio viruses are grown in monkey kidney cells. Rubella, rabies, hepatitis A and some polio viruses are grown in human diploid cells. This cell line was derived from a single sample of fetal lung tissue obtained following a termination of pregnancy for medical indications 30 years ago. Great care is taken to ensure that there are no extraneous viruses in the cell cultures.

■ 2.8 **Passive immunity** results from the injection of human immunoglobulin (see Chapter 19); the protection afforded is immediate but lasts only a few weeks. There are two types:

(i) Human normal immunoglobulin (HNIG) derived from the pooled plasma of donors and containing antibody to infectious agents which are currently prevalent in the general population. Examples of the use of HNIG are the protection of immunosuppressed children exposed to measles, and protection of individuals against hepatitis A.

(ii) Specific immunoglobulins for tetanus, hepatitis B, rabies and varicella-zoster. These are obtained from the pooled blood of convalescent patients, donors recently immunised with the relevant vaccine, or those who on screening are found to have sufficiently high antibody titres. Each specific immunoglobulin therefore contains antibody at a higher titre than that present in normal immunoglobulin.

■ 2.9 Recommendations for the use of normal and specific immunoglobulins are given in the relevant chapters.