Programme: T. Y. B. Sc.

Subject: Microbiology

Course Code: MIC 108

Course Title: Immunology

Unit: 06 – Generation of Immune Response

Module Name: 6.1 - Primary and Secondary Immune Response

Module No: 19

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Notes

Outline: Primary Immune Response, Secondary Immune Response

Immune response: collective and coordinated response to the foreign substance in an individual mediated by the cells and molecules of the immune system.

Immune memory: is a major characteristic of the adaptive immune response.

Primary and Secondary Responses of humoral (antibody-mediated) immunity:

Starting with a B cell, an antibody-mediated immune response begins with antigen exposure and culminates with the production and secretion of antigen-specific antibodies. Antibodies produced by a single cell are homogeneous but the response to a given Ag involves many different specific antibody producing cells and therefore, is very heterogeneous i.e.multiclonal.

The primary immune response:

Occurs when an individual is exposed (first exposure) to an exogenous antigen (e.g. an infection or vaccine). During this time, the immune system has to learn to recognize antigen and how to make antibody against it and eventually produce memory lymphocytes. Following the initial antigen exposure, each antigen-stimulated B cell multiplies and differentiates to form antibody-secreting plasma cells and memory B cells. Plasma cells in this *primary antibody response* are

relatively short-lived (less than one week) but produce and secrete large amounts of mostly IgM antibody. After a latent period of several days, antibody appears in the blood and a gradual increase in *antibody titer* (antibody quantity) occurs. As antigen disappears, the primary antibody response slowly diminishes.

The kinetics of the primary response depends on: nature of the antigen, route of antigen administration, presence or absence of adjuvants and species or strain being immunized.

The Primary Antibody Response: Primary antibody response is divided into four phases:

i) Lag phase, ii) Log phase, iii) Plateau or steady phase, iv) Phase of Decline

A primary response to antigen is characterized by a lag phase or latent period, of several days to weeks before an antibody response is established, during which naïve B cells undergo clonal selection, subsequent clonal expansion, and differentiation into memory cells or plasma cells.

The memory B cells formed during a primary response stop dividing and enter the G0 phase of the cell cycle. These cells have variable life spans, with some persisting for the life of the individual. The duration of the lag phase varies with the nature of the antigen. During this latent period, no Ag-specific antibody can be detected in the blood. The lag phase is followed by a logarithmic increase in serum antibody level, which reaches a peak, plateaus for a variable time, and then declines. In the decline phase, antibodies are naturally metabolized or are bound to the antigen and cleared from circulation.

The secondary immune response (Memory or Anamnestic Response):

Occurs when the second time (3rd, 4th, etc.), the person is exposed to the same antigen within weeks, months, or even years (when an individual is reexposed to a pathogen or receives a vaccine booster). At this point immunological memory has been established and the immune system can start making antibodies immediately. Memory effect forms the basis for giving boosters - additional doses of vaccine.

In the Secondary Responses of humoral immunity:

Under the influence of T - helper cells, IgM-secreting plasma cells may switch and produce another antibody class (e.g., IgG, IgA, or IgE). This is known as antibody class or isotype switching after the second exposure to an antigen; the new class of antibody has the same specificity to the original antigen. The secondary response is a result of the persistence of antigen-sensitive “memory cells” following the first immune response, these memory cells

persist in the body for years and confer long-term specific immunity. Serum antibody titer slowly decreases (decline) over time, but subsequent exposure(s) to the same antigen can trigger another secondary response. Secondary response is prompt, powerful and prolonged. It has a shorter lag phase, more rapid log phase, persists for a longer plateau period.