



UBL201-L Introductory Biology III - Immunology

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The various organs of the Immune System in the Mouse

Question 1:

Explain what are primary and secondary lymphoid organs and their role in the immune response.

Answer: The immune system comprises of several morphologically and functionally diverse organs and tissues that contribute to the development of immune responses. On the basis of function they are classified as *primary* and *secondary* lymphoid organs.

- **Primary lymphoid organs:** The *thymus* and the *bone marrow* are the primary lymphoid organs. These are the sites within which immature lymphocytes generated in hematopoiesis mature and become committed to a particular antigenic specificity. They ensure immunocompetency of the lymphocytes.
 - **Bone marrow:** The bone marrow is a primary lymphoid organ responsible for the production of various immune cells, including B lymphocytes (B cells) and some T lymphocytes (T cells). B cells mature in the bone marrow, where they develop receptors for specific antigens, which are molecules that can trigger an immune response.
 - **Thymus:** The thymus is a bilobed organ situated above the heart. It is the site of T-cell development and maturation. T-cells originate in the bone marrow but migrate to the thymus to undergo a selection process that ensures they can distinguish between self and non-self antigens. The thymus helps shape the T cell receptor repertoire and educates T cells to be tolerant to self-antigens while responsive to foreign invaders.
- **Secondary lymphoid organs:** The *spleen*, *lymph nodes*, *tonsils*, *mucosal associated lymphoid tissue (MALT)*, *Peyer's patches*, *adenoids* and *appendix*, etc. are the secondary lymphoid organs. Secondary lymphoid organs are sites where immune responses are initiated and coordinated. When immune cells encounter antigens in these organs, they undergo activation and clonal expansion, leading to the production of effector cells (e.g., antibody-producing plasma cells and cytotoxic T cells) that can target and eliminate pathogens. Additionally, secondary lymphoid organs facilitate the interaction between different immune cells, enhancing the efficiency and specificity of the immune response.

Question 2:

What does this experiment show and is useful for?

Answer: This experiment which was conducted on mice shows the various organs of the immune system in the mouse. The dissection of the mouse involved the removal of the thymus, inguinal lymph nodes, mesenteric lymph nodes and spleen. Then we also performed spleen perforation to isolate splenocytes.

This experiment is useful to understand the location of various immunological organs in the body and also their function in the immune response. The video also makes us familiar with handling of mouse and the intricacies of dissection of the mouse for immunological studies.

Question 3:

For what purpose spleen is used in immunological assays and why?

Answer: Spleen is a secondary lymphoid organ. It is located in the upper left quadrant of the abdomen, just beneath the diaphragm. It is a highly vascular organ and is responsible for the filtration of blood. It is the site of immune responses to blood-borne pathogens, antibody production, immune cell activation and

proliferation. The spleen is a reservoir of immune cells, including macrophages, dendritic cells, B cells, and T cells which makes it an essential source for isolation of these cells. Since it is also the site where interactions between antigens and immune cells occur, it also serves as a source for studying immune response. It is the largest lymphoid organ in the body, hence easily accessible and becomes useful in immunological assays.

Question 4:

What if lymphoid organs are removed, how would this affect immunity in mouse?

Answer: The lymphoid organs are the sites where the immune response is initiated and coordinated. The removal of lymphoid organs would affect the immune response in the mouse as it would not be able to mount an immune response against the pathogen and would be susceptible to infections.

It will be Impaired in its ability to recognize antigens and activate an immune response, resulting in the following:

- Impaired Antigen Recognition and Activation
- Reduced Antibody Production
- T Cell Deficiency
- Impaired Immune Memory
- Increased Susceptibility to Infections
- Autoimmune Risk
- Impaired Wound Healing
- Impaired Cancer Immunosurveillance
- Impaired Immune Response to Vaccines
- Impaired Immune Response to Allergens

Hence, the mouse would be immunocompromised and would succumb to the simplest of infections.

Question 5:

What is a nude mouse and explain its use in immunology?

Answer: A “nude mouse” is a laboratory mouse strain that is characterized by a genetic mutation that results in a lack of a functional thymus gland, which in turn leads to a severe immunodeficiency. This genetic mutation is caused by a recessive autosomal mutation in the *Foxn1* gene. The nude mouse is named as such because it lacks a typical fur coat, giving it a hairless appearance.

The absence of a functional thymus in nude mice results in a lack of T lymphocytes (T cells) in their immune system. T cells are a critical component of the immune system and play a central role in cell-mediated immunity, including the recognition and elimination of virus-infected cells and cancer cells. Since nude mice have a deficiency in T cells, their immune responses, especially those related to cellular immunity, are severely compromised.

The use of nude mice in immunology research is significant and valuable for several reasons:

- Tumor studies
- Xenograft studies
- Stem cell research
- Autoimmune and infectious disease research
- Drug development and testing.