

## Unit 6- Ontogeny of Fish Immune System

### Ontogeny of Fish Immune System

In fish, as in all vertebrates, the thymus is the first lymphoid organ to develop and to become lymphoid. Later kidney and spleen develops as lymphoid organ and remaining throughout life. In the early life of the carp, the thymus contribute majorly to lymphoid cell pool (70% or about  $3 \times 10^5$  cells at day 28). Later as the organism grows say at 2 months of age, the total lymphocyte cell pool ( $5 \times 10^6$  cells) was distributed among the lymphoid organs with 38% in the mesonephros, 32% in the thymus, 15% in the pronephros, 12% in the peripheral blood, and 3% in the spleen.

The development of the lymphoid system in fish is explained by two hypotheses.

- Natural selection will favor individuals in which development of the immune system coincides with their first exposure to potential pathogens either from their environment or in their food (i.e., hatching in oviparous species, parturition in viviparous species, or at the time of first feeding).
- Development of the lymphoid organs occurs at a preset time during embryogenesis. Once a certain "physiological age" has been reached lymphoid organs develop and is independent of first exposure to antigenic challenge.

The state of immunological maturity of the fish may be correlated with the age, weight, and water temperature. The weight of fish is approximately 0.24 g when the first antibody is detected.

### Evidence for Ig in the Eggs and Passive Transfer of Immunity from Mother to Young

Nonspecific humoral factors, such as C-reactive protein and lectin-like agglutinins are found in fish egg, in addition to that Immunoglobulin has also been detected in both fertilized and unfertilized eggs of carp. The levels in the whole fish increased slowly to reach a peak, in terms of milligrams per gram of tissue, at the time of hatching, and slowly decline. IgM-like protein was maternally derived and that it was depleted by the time of first feeding, after which the larvae start to produce their own.

### Ontogeny of T and B Cells in Lymphoid Organ Development

The sIg<sup>+</sup> cells (cells bearing Ig on their surface) could be detected in the thymus and pronephros from day 14 after fertilization, and in the mesonephros and spleen from day 28. Cytoplasmic Ig<sup>+</sup> cells (cells bearing Ig in their cytoplasm) were first seen in the pronephros at day 21. The percentage of sIg<sup>+</sup> cells increased gradually to the age of 16 months, with 15.8-48.1% for blood, pronephros 9.7-21.6%, mesonephros 7.2-16.8% , spleen 15.9-21.6% , and thymus 1.5-3.7%. but in the case of cIg<sup>+</sup> cells, the percentage was very low or even absent in spleen, thymus, and blood. Plasma cells were not found in the kidney of the fishes of the age below 1 month old and 0.17% can be seen in the fishes of 1 month old followed by increase in plasma cells, and increased to 1% at the age of 8 months.

### Ontogeny of nonspecific immunity

Along with maternally derived immune protection in newly hatched fry a variety of nonspecific defence mechanisms develops prior to specific immunity. Nonspecific immunity is the major defence mechanism in earlier life before the specific mechanism is fully developed. Where the nonspecific lectins and hemagglutinins found in fish eggs and fry, in

addition to this presence phagocytic cells can be seen in newly hatched fry. This nonspecific immunity helps in defending the fish throughout the life. Non specific defence system also plays a significant role when the specific immune response is suppressed

### **Ontogeny of specific immunity**

Matured T lymphocytes that can function in defence system can be seen soon after their morphological appearance in about 14-18 days after hatching. The presence circulating antibodies in the blood indicates activation of specific immunity in tern the presence of matured plasma cell can be seen in carp at the age of 4 month. Also the development of these immune system depends on temperature.